State of New York — Department of Agriculture

Eighteenth Annual Report

OF THE

BOARD OF CONTROL

OF THE

NEW YORK

Agricultural Experiment Station

The Report of the Commissioner of Agriculture, for 1899, consists of three volumes, as follows:

Volume I. Seventh Annual Report of the regular work of the Department of Agriculture, as required by section 5 of chapter 338 of the Laws of 1893.

Volume II. Twelfth Annual Report of the Cornell University Agricultural Experiment Station, made to the Commissioner of Agriculture in compliance with the provisions of section 87 of chapter 338 of the Laws of 1893.

Volume III. Eighteenth Annual Report of the New York Agricultural Experiment Station, made to the Commissioner of Agriculture in accordance with the provisions of section 85 of chapter 338 of the Laws of 1893.

JAMES B. LYON, STATE PRINTER.
1900.

State of New York — Department of Agriculture

EIGHTEENTH ANNUAL REPORT

OF THE

BOARD OF CONTROL

OF THE

NEW YORK

Agricultural Experiment Station

(GENEVA, ONTARIO COUNTY),

FOR THE YEAR 1899,

WITH REPORTS OF DIRECTOR AND OTHER OFFICERS.

TRANSMITTED TO THE LEGISLATURE FEBRUARY 21, 1900.

ALBANY:
JAMES B. LYON, STATE PRINTER.
1900.

STATE OF NEW YORK.

No. 83.

IN ASSEMBLY,

FEBRUARY 21, 1900.

EIGHTEENTH ANNUAL REPORT

OF THE

Board of Control of the New York Agricultural Experiment Station.

STATE OF NEW YORK:

DEPARTMENT OF AGRICULTURE,

ALBANY, *Feb.* 21, 1900.

To the Assembly of the State of New York:

I have the honor to herewith submit the Eighteenth Annual Report of the Director and Board of Managers of the New York Agricultural Experiment Station at Geneva, N. Y., in pursuance of the provisions of the Agricultural Law.

I am, respectfully yours,

CHARLES A. WIETING,

Commissioner of Agriculture.

1899.

ORGANIZATION OF THE STATION.

BOARD OF CONTROL.

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STATION STAFF.

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WILLIAM P. WHEELER, *First Assistant (Animal Industry).*
FREDERICK C. STEWART, M. S., *Botanist.*
FREDERICK H. BLODGETT, *Assistant Botanist and Entomologist.*
FRED M. ROLFS, B. S., *Student Assistant in Botany.*
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HARRY A. HARDING, M. S., *Dairy Bacteriologist.*
LORE A. ROGERS, B. S., *Student Assistant in Bacteriology.*
GEO. A. SMITH, *Dairy Expert.*
FRANK H. HALL, B. S., *Editor and Librarian.*
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†F. ATWOOD SIRRINE, M. S.,
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WENDELL PADDOCK, B. S.,
‡CHARLES P. CLOSE, M. S.,
Assistant Horticulturists.
FRANK E. NEWTON,
JENNIE TERWILLIGER,
Clerks and Stenographers.
ADIN H. HORTON, *Computer.*

Address all correspondence, not to individual members of the staff, but to the NEW YORK AGRICULTURAL EXPERIMENT STATION, GENEVA, N. Y.
The Bulletins published by the Station will be sent free to any farmer applying for them.

* Connected with Fertilizer Control.
† Connected with Second Judicial Department Branch Station.
‡ Resigned September 19, 1899.

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Eighteenth Annual Report

OF THE

Board of Control of the New York Agricultural Experiment Station.

TREASURER'S REPORT.

Geneva, N. Y., *October* 1, 1899.

To the Board of Control of the New York Agricultural Experiment Station:

As Treasurer of the Board of Control, I respectfully submit the following report for the fiscal year ending September 30, 1899.

Maintenance Account.

Receipts.

1898.			
Oct.	1.	To balance on hand	$591 77
		To amount received for produce sold .	2,105 20
		To amount received from Comptroller,	60,000 00
			$62,696 97

Expenditures.

By building and repairs	$1,359 97
By chemical supplies	892 27
By contingent expenses	649 11
By feeding stuffs	945 72
By fertilizers	26 08

By freight and express	$494 21
By furniture and fixtures	1,177 46
By heat, light and water	2,554 06
By labor	12,695 54
By library	676 54
By live stock	434 00
By postage and stationery	1,170 30
By publications	2,640 81
By salaries	21,232 88
By scientific apparatus	961 05
By seeds, plants and sundry supplies,	1,974 69
By tools, implements and machinery	739 63
By traveling expenses	1,232 88
By balance	10,839 77
	$62,696 97

EXPENSE OF BULLETINS AND ENFORCING PROVISIONS OF CHAPTER 955, LAWS OF 1896.

Receipts.

1898.			
Oct.	1.	To balance on hand	$1,954 99
		To amount received from Comptroller,	10,000 00
			$11,954 99

Expenditures.

By chemical supplies	$940 28
By contingent expenses	4 30
By freight and express	36 89
By furniture and fixtures	1 40
By heat, light and water	522 98
By postage and stationery	13 71
By publications	2,459 47
By salaries	5,629 18

By seeds, plants and sundry supplies..	$3 35
By traveling expenses	1,023 12
By balance	1,320 31
	$11,954 99

SECOND JUDICIAL DEPARTMENT, CHAPTER 675, LAWS 1894.

Receipts.

1898.			
Oct.	1.	To balance on hand	$46 34
		To amount received from Comptroller,	7,466 80
			$7,513 14

Expenditures.

By chemical supplies	$10 09
By contingent expenses	15 13
By fertilizers	216 80
By freight and express	119 04
By furniture and fixtures	95
By heat, light and water	34 52
By labor	815 13
By library	5 85
By postage and stationery	8 33
By publications	565 90
By salaries	2,872 08
By scientific apparatus	74 25
By seeds, plants and sundry supplies..	482 82
By tools, implements and machinery..	101 92
By traveling expenses	852 99
By rent (land)	1,291 00
By balance	46 34
	$7,513 14

SPECIAL APPROPRIATION FOR BIOLOGICAL AND DAIRY BUILDING, CHAPTER 315, LAWS 1897.

Receipts.

1898.			
Oct.	1.	To amount received from Comptroller,	$8,994,37

Expenditures.

By construction	$6,186 32
By equipment	2,808 05
	$8,994 37

SPECIAL APPROPRIATION FOR BUILDINGS AND REPAIRS.

Receipts.

1898.			
Oct.	1.	To amount received from Comptroller,	$885 09

Expenditures.

By buildings and repairs	$885 09

PARIS GREEN LAW, CHAPTER 113, LAWS 1898.

Receipts.

1898.			
Oct.	1.	To amount received from Comptroller,	$123 90

Expenditures.

By contingent expenses	$0 20
By freight and express	2 15
By postage and stationery	25
By salaries	45 00
By seeds, plants and sundry supplies. .	4 16
By traveling expenses	72 14
	$123 90

I have remitted to the State Treasurer $235.21 for produce sold.

All expenditures are supported by vouchers approved by the auditing committee of the Board of Control, and have been furnished the Comptroller of the State of New York.

UNITED STATES APPROPRIATION UNDER ACT OF CONGRESS, APPROVED MARCH 2, 1887.

To receipts from the Treasurer of United States for fiscal year ending June 30, 1899	$1,500 00

Expenditures.

By salaries	$1,500 00

WILLIAM O'HANLON,
Treasurer.

DIRECTOR'S REPORT.*

To the Honorable Board of Control of the New York Agricultural Experiment Station:

Gentlemen.— I have the honor to present herewith the report of the progress and work of the New York Agricultural Experiment Station for the year 1899.

The year 1898 was characterized by large and important additions to the building and apparatus equipment, but the past year has been occupied chiefly with the quiet study of certain important problems.

It is a pleasure to report to you that without exception the members of the various departments of the Station are giving to their work a very gratifying measure of diligence and efficiency. The pursuit of knowledge with the attendant vicissitudes of original observation and research requires enthusiasm and courage, especially when the long delay of results may cause public criticism; and he who keeps on his way in a spirit of loyalty to truth and with a proper sense of responsibility for his utterance is deserving of his full meed of praise. I believe the members of your Station staff recognize the high standard to which they should attain and are striving to reach it.

THE STATION STAFF.

After more than three years of efficient service at the Station as Assistant Horticulturist, Mr. C. P. Close resigned his position in September last to accept the chair of Botany and Horticulture in the Utah Agricultural College. A successor to Mr. Close has not yet been selected.

* Reprint of Bulletin No. 168.

Mr. Lowe was granted a six months' leave of absence and is now pursuing special zoological studies at the University of Chicago.

STUDENT ASSISTANTS.

So far in the history of American experiment stations the number of well trained young men available from which to choose investigators has been altogether too limited, especially in biological lines. Graduates of our colleges when fresh from laboratory instruction seldom have much facility in making a logical attack upon a difficult problem affecting practice until after they have been for a time in the atmosphere of real research. It was felt that it would be possible to associate with our work young men having taste for investigation in experiment station lines, in such a way as to derive mutual benefit. In view of this conclusion and in accordance with authority granted me by you, a circular letter containing the following statements was addressed to a large number of the land grant colleges:

"By authority of the Board of Control of this Station, we are prepared to admit to our laboratories three student assistants; one in each of the departments of botany (plant pathology), bacteriology (dairy), and entomology. In order to be eligible to these positions, candidates must be graduates of a four years' course in science, preferably at a land grant college where the sciences are taught with especial reference to their bearing upon the art of agriculture. It is essential, moreover, that such candidates shall have pursued studies specially fitting them to undertake work in one of these departments and that they shall have shown such proficiency and enthusiasm in special directions as will warrant their choosing one of these lines of study and investigation for a life work.

"As their main work, it is proposed, under the guidance of the heads of departments, to associate these assistants with one or more important subjects of investigation, with the understanding that they shall devote a minor proportion of each day, perhaps two hours, to the care of the laboratories, preparation of materials and other routine duties. They must be prepared to enter immediately, under proper direction, upon a study of one or more problems, without spending a considerable period of time in acquiring the necessary preparatory knowledge and skill of a fundamental character. For instance, the student assistant in bacteriology should be familiar in a practical way with the technics of making culture.

"Full credit will be given in our publications for work accomplished,

"It is hoped that the observation and experience gained by such close association with the actual research work of an experiment station will constitute a valuable training for those who are ambitious to connect themselves with experiment stations as investigators.

"The selection of these assistants will properly and necessarily be based upon their records as students and upon such knowledge of their personality as may be gained in various ways.

"It is expected that they will remain at the Station not less than one year. Board, rooms and laboratory materials will be furnished free of charge, no other compensation being offered."

From the applicants for these positions, two were selected, Mr. L. A. Rogers, as student assistant in Bacteriology, and Mr. E. D. Merrill, as student assistant in Botany. Both men graduated from the University of Maine and had received some post-graduate training. Mr. Rogers had spent a year at the University of Wisconsin, giving special attention to dairy bacteriology, and Mr. Merrill had had a year's experience as instructor in the department of natural history at his alma mater. The former entered upon his work in June, but the latter, on the day in which he reported to us for duty, received an offer of a position in the U. S. Department of Agriculture which he felt that it was for his interest to accept. Since that time Mr. F. M. Rolfs, a graduate of the Iowa Agricultural College, and a teacher of considerable experience, became an applicant for the position of student assistant in Botany, received the appointment and entered upon his duties on December 21st.

As there was no application for the position in Entomology, it remains unfilled.

NEEDED CHANGES AND ADDITIONS.

The time has come when it is necessary to provide larger and more efficient accommodations for the various administrative offices and the library. These are now mostly located in a building the upper floors of which are occupied by the Director as a home, an arrangement which is unsatisfactory in every respect. There is at present only one general office in which are the desks of the Director and two clerks, a combination which

results in great inconvenience. The mailing department is temporarily located on the second floor of the Chemical Laboratory, rendering it necessary to carry up and down stairs many tons of mailing matter yearly. All of the administration work of the Station and the library should be newly installed under one roof, for reasons of space as well as economy of labor.

Two general ways of accomplishing this have been considered: One proposition is to erect a new administration and library building and convert the house where the offices now are wholly to domestic purposes; the alternative is to build a new director's house and turn over the mansion house wholly to office and library uses. The arguments in favor of the former course are that the administration and library building should correspond in dignity and attractiveness to the other structures on the Station grounds, and besides new construction would give an opportunity to make the offices models of convenience and efficiency, without being hampered by the limitations of an existing structure. This is the more costly plan, involving an outlay of not far from $32,000. On the other hand a new house would place the director on a more comfortable and economical living basis than would be the case if the somewhat overlarge house in which he now lives were given over wholly to his occupancy, while this building is probably large enough for the administrative offices and library, though if reconstructed for these purposes it would fail, as has been stated, of the dignity and convenience of a new building. The probable cost of the second proposed plan would be somewhere from $16,000 to $19,000. The argument of less cost is with the second proposition.

It seems proper to state in this connection that the water supply of the Station is in some respects very unsatisfactory. It is furnished by the city at an annual cost of $501, and if the pressure on the hydrants was such as to insure protection against fire, and at the same time provide a constant and uniform flow of water in the laboratories, there might be no good reason for con-

sidering a change. The conditions which prevail are the reverse of these, however, especially during the summer. Whenever hydrant pressure is available it averages less than twenty pounds, and at times it is a minus quantity, a condition which often causes great inconvenience in laboratory work and especially in running the refrigerating machine, besides being practically useless for fire purposes. It seems desirable for your board to consider whether any improvement in our water supply is possible.

INSPECTION OF FERTILIZERS AND FEEDING STUFFS.

The Legislature of 1899 made two enactments which both modified and enlarged the inspection work of the Station.

The Fertilizer Law was so amended as to require the payment of a license fee of $20 on each brand of commercial fertilizers sold or offered for sale in the State, thus bringing New York into line with the other twenty-eight states in which fertilizer laws exist. The money received from such fees is to be devoted to paying the expenses of inspection, which renders unnecessary the appropriation heretofore made by the state for this purpose. In 1898 the number of brands of fertilizers registered at the Station by manufacturers was 2,226, and it now seems probable that in 1899 it will fall to less than 500. This decrease is not caused wholly by the imposition of license fees, but without question is due in part to the formation of a fertilizer combination or trust. Some have thought that the advance in prices is also the result of the exaction of license fees, but this surely cannot be so, because the total annual expense of such fees to the fertilizer industry will not exceed an average of six cents per ton on the quantity of goods sold.

Other conditions are responsible for the increased cost to the farmer of his commercial plant food.

A new law, quite similar in its provisions and operation to the amended fertilizer law, the author of which is the Hon. D. P. Witter, was also enacted for the control and inspection of con-

centrated commercial feeding stuffs. As with fertilizers, manufacturers of feeding stuffs must register at the Station a guaranteed composition and pay the annual license fee on each brand sold or offered for sale, the proceeds thus derived to be used i the yearly collection and analysis of samples by the Station and the printing of results. It now seems that the brands registered will not exceed one hundred, so that the revenue produced by this law will not be large. Attention is called to the fact that in the case of both laws, the license fees are paid into the state treasury and the amounts of money thus received by the state only become available for their legitimate uses after appropriation by the legislature.

THE MAILING LIST.

The present status of the mailing list is as follows:

Popular Bulletin List.

Residents of New York	30,337
" " other states	992
Newspapers	744
Experiment Stations and their staffs	778
Miscellaneous	131
Total	32,982

Complete Bulletin List.

Experiment Stations and their staffs	778
Libraries, scientists, etc.	257
Foreign list	55
Individuals	902
Miscellaneous	131
Total	2,123

The above figures show a small increase in the popular bulletin list for residents of New York. During the past year this list

has been revised, resulting in taking off the names (not less than 2,000) of those who had died or changed their place of residence. There has been a steady registering of new names, however. This growth is normal and not forced, coming as it does almost wholly from individuals who personally ask to receive the bulletins of the station.

THE STATION LIBRARY.

A good library is a most necessary part of an experiment station equipment. Research can neither be entered upon safely nor its results discussed intelligently unless the investigator has access to the records of what has been learned previously concerning the subjects under consideration. Access to current literature and particularly to the journals which are the organs of research, is especially important in this connection.

The library of this Station has developed rapidly during the past two years, but it is still small and in some respects quite insufficient for our needs. A fairly large number of journals is received, but complete sets of them should be obtained as rapidly as possible. The present number of bound volumes and pamphlets in the library is approximately five thousand.

A list of the papers and journals obtained by subscription and donated to us by exchange or otherwise is appended to this report.

THE STATION PUBLICATIONS.

The public is not unnaturally inclined to measure the usefulness of an experiment station by the quantity of literature which it publishes. If this standard is applied to the New York State Station, the year 1899 will appear to be less profitable than some which have preceded. As a matter of fact, however, there probably has not been a period in the history of the Station when so much hard study has been applied to so large a number of problems as has been the case during the past twelve months.

The number of pages of printed matter which a station issues has no necessary relation to the actual magnitude of the effort of

investigation. A bulletin of one hundred pages, which is merely a compilation of existing knowledge, may be begun and finished within the limits of a few weeks, whereas the data derived from one or more years of laborious observation may be summarized for public use on ten pages.

Two facts are likely to restrict the literature emanating from this Station to a less quantity than may seem to some to be consistent with its equipment.

(1) It is deemed to be a proper policy on the part of the Station to issue comparatively few bulletins of compilation of a purely informational character. More or less discussion of existing knowledge is necessary in order to give to the results of research a proper setting and illumination, but it is certainly not the function of the Station, now that its existence and purposes are well understood, to engage in the work of popular instruction. To do this would be to encroach upon the province of the school and of current literature. It might seem justifiable for this Station to digest and summarize for the use of New York farmers the knowledge gained by the stations in other states, were it not for the fact that the U. S. Department of Agriculture is doing this admirably through the Office of Experiment Stations. It is conceded that when emergencies arise or when an entirely new situation faces the agricultural public, like the sudden inroad of devastating insects or the establishment of the sugar beet industry, farmers are justified in looking to the Station for information of a general character. This is a different matter, however, from writing general treatises on a great variety of subjects. This institution, in my judgment, will do well to restrict its efforts quite closely to the work of experimental research.

(2) It has become imperative that this Station attack some of the more difficult scientific problems relating to agriculture. Many of the "easy questions" have been asked and answered and for this reason, and also because the "hard answers" are the

ones we most need to know, we should begin to probe more deeply and laboriously beneath the surface of things. There is, moreover, a pronounced tendency now evident in many quarters to withhold the publication of conclusions until they are abundantly justified by data, a most healthy and encouraging symptom in experiment station activity. The members of this Station believe in trying to enter upon the policy thus outlined and it is to be hoped that in so doing they will have the sympathy and loyal support of New York farmers.

It should be remembered that this policy means the publication of fewer bulletins than might otherwise be issued if the practice of compilation and profuse writing were adopted.

THE WORK OF THE STATION DURING 1899.

On subsequent pages there may be found summaries of the work carried on during the year 1899 by the various departments of the Station. These include a brief review of facts and conclusions contained in the year's bulletins as well as a statement of the nature and bearing of experiments and investigations, the data from which are not yet sufficiently complete and concerning which nothing has yet been published. It so happens that just now the unfinished work is large. It embraces several investigations in plant nutrition, animal nutrition, cheese curing, horticulture, bacteriology and plant pathology:

The availability of certain insoluble phosphates to several varieties of plants.

The relative importance of potash and soda in plant nutrition.

The effect of fineness upon the availability of crude phosphates.

The plant food needs of fruits and the effect of certain plant food elements upon their quality.

Relative economy of different systems of feeding crops.

A study of apple cider and vinegar.

The source of milk fat and observation on the use of food by milch cows.

The chemistry and bacteriology of cheese curing.

Study of cheese curing troubles such as rust, and sweet and bitter flavors.

Conditions of cheese curing.

The prevention of onion smut.

The prevention of asparagus rust.

A study of black knot.

The irrigation of small fruits.

Chestnut growing.

CHEMICAL DEPARTMENT.

(1) *Fertilizer inspection.*—The fertilizer trade has continued to present during 1899 its usual grotesque features. One hundred and ninety manufacturers, sixty-seven of whom are located outside of New York, registered at the Station 2,268 different brands. For various reasons the number of brands sold in the State is much short of registration. This burdensome and unsatisfactory state of affairs will doubtless end with 1899, as the number of brands registered is likely to drop to 500 or less, for reasons already explained.

(2) *Paris green and insecticide supervision.*— Twenty-five samples of Paris green were secured and analyzed. Twenty different manufacturers represented. Arsenious oxide found in Paris green varied from 55.34 to 60.16 per ct., indicating a good degree of commercial purity.

(3) *Plant nutrition.*— Work is being continued in investigation relating to the plant-food needs of fruits and the effect of certain plant-food elements upon the quality of fruits. Results are being held for additional data before publication.

(4) *Composition of cider and vinegar.*— This work has been continued two years and valuable results are being secured, but another year's data are desired before publishing the results of investigation.

(5) *Cheese work.*— Data for publication will probably be ob-

tained in addition to those on hand during the coming year. Chemical work has been directed in two lines:

(a) Studying the influence of moisture and temperature upon the composition of cheese, working with the temperatures 55°, 60°, 65° and 70° F.

(b) Studying the chemical compounds formed in cheese by the breaking down of milk casein.

HORTICULTURAL DEPARTMENT.

The fertilization of self-sterile grapes.— It has been shown in Bulletin 157 and other prior publications of this Station, that certain kinds of American grapes are either self-sterile or very imperfectly self-fertile. When self-pollinated the former bear no fruit and the latter produce very imperfectly formed clusters or usually none at all. In considering the practical bearing of these discoveries upon the selection of varieties for planting and the advantageous arrangement of them in vineyards for securing well filled fruit clusters, the question arose whether any other variety which blooms at the same time with the one which is to be fertilized will perform the necessary cross fertilizing successfully or whether some kinds of grapes are better fertilizers than others. Scarcely any definite information on this subject could be found. The matter being one of obvious practical importance to viticulturists, some investigations concerning it were begun in 1899. Very marked results have already been secured, indicating that a variety which is more or less incapable of fertilizing itself generally fails in the fertilizing of other self-sterile varieties, while on the other hand the self-fertile varieties have usually been successful in fertilizing the self-sterile sorts upon which they have been tried. Further investigation is necessary to determine whether any grape may be more successful in fertilizing some varieties than others. Various other tests need to be made before a final report is given stating definitely the conclusions which may be drawn concerning the question under investigation.

The treatment of diseases and insects is of perennial interest to fruit growers. A bulletin has been prepared on this subject by the collaboration of the Horticulturist, the Botanist and the Entomologist for the purpose of presenting up-to-date directions for fighting these enemies of the fruit grower and showing the particular instances in which various diseases and insects may be combated with one general treatment. The preparation of spray mixtures and the apparatus for applying them are treated in Bulletin 121, prepared by Mr. Paddock. This has been supplemented by publishing an appendix which treats of recently improved apparatus and gives formulae for the preparation of various spraying mixtures.

Thinning apples.— Experiments have been in progress for four years for the purpose of gaining definite information concerning the effect which thinning the fruit of apple trees may have on the remaining crop and whether the practice if followed systematically year after year tends to secure greater regularity in bearing or increased yield in succeeding seasons.

The results show that with certain varieties the size and color of the fruit are generally improved where thorough and timely thinning is done and the percentage of the higher grades of fruit is increased, although the total yield of marketable fruit is often lessened. It appears that under certain circumstances, and especially with certain varieties, the thinning of apples in commercial orchards would be profitable.

With mature trees which have come into full bearing and which are properly fertilized, pruned, sprayed and generally well cared for, it is doubtful whether thinning the fruit in any one season will materially increase the yield in succeeding seasons. It should be borne in mind that young trees which have not come into full bearing may be seriously impaired in vigor and in subsequent fruit production by being allowed to mature too heavy crops.

It appears that, with the exception noted, the principal source

of profit from thinning fruit in orchards which are well cared for is to be looked for chiefly in preventing the breaking of overloaded limbs and in the increased market value of the fruit of the current season.

Thinning, to be most effective, should be done early in the season — at the time Baldwins and Greenings are from three-fourths of an inch to an inch in diameter. In New York State it should be completed in June.

Thinning stone fruits.— Experiments in thinning apricots, plums and peaches have been in progress three seasons. With these fruits as with apples the effect of thinning is not always as pronounced the following year as had been expected. In some cases there appeared to be real permanent advantage and an increased yield in succeeding seasons, and again the effect, if any, on the crop of the following year, was in some cases obscured by causes not understood and no advantage from the previous year's thinning of the fruit could be seen. In some cases trees which were heavily loaded and not thinned gave even greater yields the following season than were obtained from corresponding trees on which the fruit had been severely thinned.

Early and severe thinning in general increased the percentage of the higher grades of fruit. Where the fruit grower can obtain correspondingly better prices for fancy fruit the thinning may doubtless be made profitable with selected varieties of peaches and apricots and in some cases with plums also.

Chemical analyses of fruits which were picked at different stages were made in the chemical department which showed that the amount of potash in the fruit of one variety of peach increased 493 per ct. from June 24 to July 21. The nitrogen increased 240 per ct. and the phosphoric acid 327 per ct. in the same period. The amount of potash in the fruit of a certain variety of plum increased in the same period 296 per ct., the nitrogen 222 per ct. and the phosphoric acid 156 per ct. This indicates how rapidly the fruits take up plant food in the very

early stages of their growth and emphasizes the importance of doing the thinning very early in the season.

Fertilizers for forcing lettuce.— Complete commercial fertilizers which differ from each other only in material from which the supply of nitrogen is secured are being tried both alone and in combination with varying proportions of stable manure, on soils for forcing lettuce. Each formula is tried with head lettuce and with loose lettuce, both on medium heavy clay loam and on very light sandy loam. The object of this work is to throw some light on the question as to whether, in the forcing of lettuce, commercial fertilizers may be profitably substituted either wholly or in part for stable manure. It is desirable that the results which have been thus far obtained should receive further confirmation before being published.

Treatment for gooseberry mildew.— Because of the destructive character of gooseberry mildew and the economic importance of this disease in all parts of America where gooseberries are cultivated, experiments have been conducted for the purpose of treatin the disease on a commercial scale. Potassium sulphide has been compared with other fungicides for this purpose and very early treatments have been compared with later treatments so as to learn if possible just when to spray and what to spray with in order to hold the mildew in check most successfully. This particular line of investigation has been in progress since 1897. The results, as set forth in Bulletin 161, show that the use of potassium sulphide has been followed with better success than the use of Bordeaux mixture, lysol or formalin. Bordeaux mixture proved comparatively useless; formalin was somewhat more effective and lysol gave promising results, ranking next to the potassium sulphide. Very early spraying generally gave better results than when the first treatment was made medium early or late. Winter treatment was tested only one season. It did not give sufficient advantage to justify the expense of making it.

Apple canker.— A disease of apple tree limbs has done and is

doing an immense amount of damage to the orchards of New York as well as in many other states. The disease is not new but the injuries resulting from its attack have been thought to be due entirely to the sun-scald, so it has escaped the notice of workers in this line.

The investigation of this disease was undertaken in the spring of 1898 and was continued through the present season. It has been proven that the cankers are produced by the attack of a fungus known as *Sphaeropsis malorum* Pk., the same that produces the black rot of apples, pears and quinces. The experiments also indicate that the fungus occurs on a number of other plants.

Experiments in treating the disease are not yet complete, but it is known that in a majority of instances orchards that have been well sprayed with Bordeaux mixture for a number of years and otherwise well taken care of are much freer from canker than orchards that have not received such treatment.

As a preventive measure we feel warranted in recommending that the orchards be put in the best growing condition and then as a further preventive that they be sprayed thoroughly with Bordeaux mixture, spraying the limbs as well as the foliage and fruit; the spraying to be made at the time the trees are ordinarily sprayed for apple scab, supplemented by an earlier one given about the time the leaf buds begin to unfold.

DEPARTMENT OF BOTANY.

Leaf-scorch of sugar beet, cherry, cauliflower and maple.— A peculiar disease of sugar beets occurring to a destructive extent in some fields in Yates and Ontario counties has been determined to have been caused by weather conditions. In early August the foliage was suddenly scorched by excessively dry, hot weather. Cherries and hard maples in the vicinity of Geneva and cauliflower on Long Island have suffered from the same cause.

Fruit-disease survey of the Hudson Valley.— A thorough survey has been made of the fruit diseases occurring in the Hudson

Valley. On account of the unusually dry season fruits generally have suffered less from disease than for several years past. Peach leaf-curl, so destructive in 1898, has been almost wholly absent. Such common destructive diseases as apple scab, pear scab, pear leaf-spot and plum leaf-spot have been injuriously abundant only in a few localities. The black rot of grapes and the fruit-rot of plums and cherries have been much less destructive than usual. The most important fact brought out by this survey is the discovery that there exists throughout the entire Hudson Valley below Albany a destructive cane blight of currants caused by a sterile fungus about which but little is known.

Miscellaneous studies on plant diseases.— In 1898, a serious rot of onions occurred in Orange county. It has been determined that this rot was caused by bacteria working in the presence of water. The prompt removal of surface water from the onion fields is probably the best that can be done to prevent the rot.

Dodder has been found on greenhouse cucumbers and a powdery mildew on field cucumbers.

The brown sunken spots on Baldwin apples have been shown to be of non-parasitic origin.

A new fungus leaf-spot disease of carnations has been discovered.

Unfinished work.— Considerable work has been done upon the stem-rot diseases of the carnation, and an investigation of the black knot disease of plums and cherries commenced.

DEPARTMENT OF BACTERIOLOGY.

Pasteurization for butter making.— A fundamental investigation of this problem has been begun in connection with the Dairy Department, the first step being a study of the effect of the various temperatures to which milk can be exposed in the " continuous " machines. A momentary exposure at 158° F. was not found satisfactory; 176° F. is much better and in many cases 185° F. is desirable. When the most acceptable temperature is

decided upon the subject of pasteurized *vs.* unpasteurized butter will be taken up.

Cheese faults.— Rusty spot in Cheddar has received considerable attention. A germ has been isolated which on being added to a vat of milk produced rusty spots in the resulting cheese. Work will be continued with a hope of finding the way in which the trouble gains entrance to the factory as well as the best method of removing it.

Work has also been done on *sweet* or *fruity* flavor but owing to the obscure nature of the trouble little headway has been made. *Bitter* flavor in Neufchatel has been reported and the trouble found due to the presence of certain acid forming bacteria. This investigation is still in progress.

Cheese ripening.— Several experiments have been carried out, alone, and in conjunction with the Department of Chemistry. The attempt has been made to exclude the action of germs in order that the activity of the enzyme naturally present in the milk and cheese might be more carefully studied.

Black rot of cabbage and cauliflower.— In collaboration with the Department of Botany field experiments on the treatment of the black rot of cabbage and cauliflower have been conducted at Phelps and on Long Island; but owing to the unusually dry season the disease was not prevalent and consequently few results were obtained. These experiments will be repeated next season.

ANIMAL INDUSTRY.

Animal food in poultry feeding.— It was found in a number of feeding experiments with chicks, ducklings and laying hens that rations containing animal food gave almost invariably better results than did those consisting entirely or very largely of vegetable food. For convenience "animal meal" was made the principal animal food. Many grain foods were used; but when rations were so arranged that the proportion of protein was alike for two rations the one with the animal food contained generally more fat and always a much larger percentage of mineral matter.

The first series of experiments did not definitely indicate the cause for the superiority of the one ration. It appeared that the more favorable results when animal food was fed might be due either to the more efficient forms of the nitrogen compounds or with the rapidly growing young birds and the laying hens to the much larger proportion of ash consisting largely of phosphates.

Subsequent experiments have shown that while ducklings require a certain amount of animal food, hens and chicks are able to do well on wholly vegetable food, supplemented by ash rich in phosphates. In these experiments, rations of vegetable food, to which bone ash was added to make up the assumed deficiency of ash, in growing chicks gave identical results with those from rations containing animal food. With laying hens the rations were equally efficient for most of the time but good results were not sustained quite so long by the vegetable food ration. The addition of bone ash did not, however, enable ducklings to make as good use of a ration wholly of vegetable foods; such a ration being decidedly less efficient than one containing animal food.

BULLETINS PUBLISHED IN 1899.

No. 158 — May.— Combating the striped beetle on cucumbers. F. A. Sirrine. Pages 32, plates 2.

No. 159 — October.— The forest tent caterpillar. V. H. Lowe. Pages 30, plates 6.

No. 160 — October.— Report of analyses of commercial fertilizers for the spring of 1899. L. L. Van Slyke. Pages 90.

No. 161 — November.— Treatment for gooseberry mildew. C. P. Close. Pages 12, plates 2, diag. 1.

No. 162 — November.— Leaf scorch of the sugar beet, cherry, cauliflower and maple. F. C. Stewart. Pages 14, plates 6.

No. 163 — December.— The New York apple-tree canker. Wendell Paddock. Pages 28, plates 6.

No. 164 — December.— Notes on various plant diseases. (A bacterial rot of onions; powdery mildew on field-grown cucumbers; dodder on cucumbers under glass; Baldwin fruit-spot; a *Fusarium* leaf-spot of carnations; *Chaetomium contortum* on barley seedlings.) F. C. Stewart. Pages 15, plates 4.

No. 165 — December.— Report of analyses of Paris green and other insecticides. L. L. Van Slyke. Pages 10.

No. 166 — December.— Commercial feeding stuffs in New York. W. H. Jordan and C. G. Jenter. Pages 42.

No. 167 — December.— A fruit disease survey of the Hudson Valley in 1899. F. C. Stewart and F. H. Blodgett. Pages 34, plates 3, map 1.

No. 168 — December.— Director's report for 1899. W. H. Jordan. Pages 22.

No. 169 — December.— Fertilizing self sterile grapes. S. A. Beach. Pages 41, plates 2.

No. 170 — December.— Diseases and insects injurious to fruits. S. A. Beach, V. H. Lowe and F. C. Stewart. Pages 65.

No. 171 — December.— Animal food for poultry. W. P. Wheeler. Pages 46, plate 1.

No. 172 — December.— The efficiency of a continuous Pasteurizer at different temperatures. H. A. Harding and L. A. Rogers. Pages 24, figs. 2.

No. 173 — December.— Report of analyses of commercial fertilizers for the fall of 1899. L. L. Van Slyke. Pages 22.

W. H. JORDAN, *Director*.

New York Agricultural Experiment Station,
Geneva, N. Y., Dec. 30, 1899.

APPENDIX.

PERIODICALS RECEIVED BY THE STATION.

Acker und Gartenbau Zeitung	Complimentary.
Agricultural Education	"
Agricultural Epitomist	"
Agricultural Gazette of New South Wales......	"
Agricultural Student	"
Agricultural Students' Gazette	"
Albany Journal	Subscription.
Allegan Gazette	Complimentary.
American Agriculturist	Subscription.
American Chemical Journal	"
American Chemical Society, Journal	"
American Cultivator	Complimentary.
American Entomological Society, Transactions,	Subscription.
American Fancier	"
American Fertilizer	"
American Florist	"
American Gardening	"
American Grange Bulletin	Complimentary.
American Journal of Physiology	Subscription.
American Monthly Microscopical Journal	"
American Museum of Natural History, Bulletin,	Complimentary.
American Naturalist	Subscription.
American Philosophical Society, Proceedings...	Complimentary.
American Stock Keeper	"
Analyst	Subscription.

Angelica Every Week	Complimentary.
Annales Agronomiques	Subscription.
Annales de l' Institut Pasteur	"
Annals and Magazine of Natural History	"
Annals of Botany	"
Archiv der gesammte Physiologie (Pflueger) ..	"
Archiv fuer Hygiene	"
Association Belge des Chimistes, Bulletin.....	Complimentary.
Baltimore Weekly Sun	"
Beet Sugar Gazette	"
Berichte der deutchen botanischen Gesellschaft,	Subscription.
Berichte der deutschen chemischen Gesellschaft,	"
Boletin do Instituto Agronomico do Estado de Sao Paulo	Complimentary.
Boletin de Agricultura, Mineria e Industrias...	"
Boletin de Agricultura Tropical	"
Boston Society of Natural History, Proceedings,	Subscription.
Botanical Department, Jamaica, Bulletin	Complimentary.
Botanical Gazette	Subscription.
Botanische Zeitung	"
Botanisches Centralblatt	"
Botaniste, Le	"
Buffalo Society of Natural Sciences, Bulletin...	Complimentary.
Canadian Entomologist	Subscription.
Canadian Horticulturist	Complimentary.
Centralblatt fuer Agrikultur-Chemic	Subscription.
Centralblatt fuer Bakteriologie und Parasitenkunde	"
Chemical News	"
Chemical Society, Journal	"
Chemiker Zeitung	"
Chemisches Centralblatt	"
Chicago Dairy Produce	Complimentary.
Cincinnati Society of Natural History, Journal,	"

Columbus Horticultural Society, Journal	Complimentary.
Commercial Gazette	"
Cotton Planters' Journal	"
Country Gentleman	Subscription.
Country World	Complimentary.
Dairy and Creamery	"
DeRuyter Gleaner	"
Detroit Free Press	"
Dietetic & Hygienic Gazette	Subscription.
Deutsche landwirtschaftliche Wochenschrift....	Complimentary.
Elgin Dairy Report	"
Elisha Mitchell Scientific Society, Journal.....	"
English Catalogue of Books	"
Entomological News	Subscription.
Entomological Society of Washington, Proceedings	"
Entomologische Zeitschrift	"
Entomologist	"
Entomologist's Record	"
Fanciers' Review	Complimentary.
Farm and Fireside	"
Farm and Home	"
Farm, Furnace and Factory	"
Farm Journal	"
Farm News	"
Farm Poultry Semi-Monthly	"
Farm, Stock and Home	"
Farmers' Advocate	"
Farmers' Guide	"
Farmers' Home	"
Farmers' Magazine	"
Farmers' Tribune	"
Farmers' Voice	"
Feather	Subscription.

Feathered World	Subscription.
Florist's Exchange	"
Fuehling's landwirtschaftliche Zeitung	"
Garden	"
Gardeners' Chronicle	"
Gardening	"
Geneva Gazette	Complimentary.
Gleanings in Bee Culture	"
Green's Fruit Grower	"
Hedwigia	Subscription.
Herd Register	Complimentary.
Hoard's Dairyman	"
Homestead	"
Indiana Farmer	"
Industrie Laitiere	"
Irrigation Age	"
Ithaca Democrat	"
Jahresberichte der Agrikultur-Chemie	Subscription.
Jahresberichte der Nahrungs-und Genussmittel,	"
Jersey Bulletin	Complimentary.
Journal d' Agriculture Pratique	Subscription.
Journal of Applied Microscopy	"
Journal de Botanique	"
Journal of Experimental Medicine	"
Journal fuer Landwirtschaft	"
Just's Botanischer Jahresbericht	"
Landwirtschaftlicher Jahrbuecher	"
Landwirtschaftlichen Versuchs-Stationen	"
Live Stock Journal	"
Long Island Farmer	Complimentary.
Louisiana Planter	"
Meehan's Monthly	Subscription.
Milk Zeitung	"
Mirror and Farmer	Complimentary.

Montana Fruit Grower	Complimentary.
Monthly Weather Review	"
National Nurseryman	"
National Stockman and Farmer	"
Naturae Novitates	"
Naturaliste	Subscription.
Naturaliste Canadienne	Complimentary.
Nature	Subscription.
Nebraska Farmer	Complimentary.
New England Farmer	"
New York Academy of Science, Annals and Transactions	Subscription.
New York Botanical Garden, Bulletin	Complimentary.
New York Entomological Society, Journal	Subscription.
New York Farmer	Complimentary.
New York Produce Review	"
New York State Granger	"
North American Horticulturist	"
Northwest Pacific Farmer	"
Oesterreichische Chemiker Zeitung	Subscription.
Ohio Poultry Journal	"
Olean Herald	Complimentary.
Oregon Agriculturist	"
Pacific Coast Dairyman	"
Pacific Coast Fanciers' Monthly	Subscription.
Pacific Rural Press	"
Pomona Herald	Complimentary.
Popular Agriculturist	"
Poultry	Subscription.
Poultry Herald	"
Poultry Keeper	Complimentary.
Poultry Monthly	"
Practical Farmer	"
Prairie Farmer	"
Plattsburgh News	"

Progress Agricole et Viticole	Subscription.
Psyche	"
Queensland Agricultural Journal	Complimentary.
Revue Generale de Botanique	Subscription.
Revue Horticole	"
Revue Mycologique	"
Royal Agricultural Society, Journal	"
Rural New Yorker	"
Rural Topics	Complimentary.
Salt Lake Herald	"
Saint Louis Academy of Science, Transactions,	"
Sanitary Inspector	"
Science	Subscription.
Society of Chemical Industry, Journal	"
Societe Entomologique de France	Complimentary.
Societe Mycologique de France	Subscription.
Southern Planter	Complimentary.
Southern Farm Magazine	"
Southwest	"
Southwestern Farmer and American Horticulturist	"
Stazione Sperimentale Agrarie Italiane	"
Strawberry Specialist	"
Suffolk Bulletin	"
Sugar Beet	"
Torrey Botanical Club, Bulletin & Memoirs	Subscription.
Vermont Farmers' Advocate	Complimentary.
Wallace's Farmer	"
Watkins Review	"
Waverly Free Press	"
West Virginia Farm Reporter	"
Western Plowman	"
Wiener illustrierte Garten-Zeitung	Subscription.
Woman's Home Companion	Complimentary.

Zeitschrift fuer analytische Chemie	Subscription.
Zeitschrift fuer Biologie	"
Zeitschrift fuer Entomologie	Complimentary.
Zeitschrift fuer Fleisch und Milch Hygiene....	Subscription.
Zeitschrift fuer Pflanzenkrankheiten	"
Zeitschrift fuer physiologische Chemie	"
Zeitschrift fuer Untersuchung d. Nahrungs- und Genussmittel	"
Zoologischer Anzeiger	"

REPORT

OF THE

Department of Animal Husbandry.

W. H. Jordan, *Director.*
William P. Wheeler, *First Assistant.*
C. G. Jenter, *Assistant Chemist.*

Table of Contents.

REPORT OF THE DEPARTMENT OF ANIMAL HUSBANDRY.

COMMERCIAL FEEDING STUFFS IN NEW YORK.*

W. H. JORDAN AND C. G. JENTER.

SUMMARY.

In buying feeding stuffs the farmer should understand both the general character of the material, and the source and general nature of the substances composing it. It is often as important to know that the desired ingredients are not furnished by oat hulls or other indigestible wastes as it is to know the amount of these ingredients.

The terms nitrogenous and carbohydrate are too general to be used without modification in classifying feeding stuffs and the following four classes give a better grouping:

Class I. Contain 30 per ct. to 45 per ct. protein and 50 per ct. to 60 per ct. carbohydrates: Cotton-seed meal, linseed meal and gluten meal.

Class II. Contain 20 per ct. to 30 per ct. protein and 60 per ct. to 70 per ct. carbohydrates: Gluten feeds, Atlas meal, dried brewer's grains, malt sprouts, buckwheat middlings and peas and beans.

* Reprint of Bulletin No. 166.

Class III. Contain 14 per ct. to 20 per ct. protein and 70 per ct. to 75 per ct. carbohydrates: Brans and middlings from wheat and rye and some proprietary mixed feeds.

Class IV. Contain 8 per ct. to 14 per ct. protein and 75 per ct. to 85 per ct. carbohydrates: Cereal grains, cerealine, hominy and oat feeds, corn and oat chops, corn bran, corn germ feed and chop feed in general. Hays and fodders belong here more nearly than elsewhere.

Samples of feed have been collected during the past two winters and analyzed chemically, physically and often microscopically.

Cotton-seed meal should be light yellow, a dark color usually indicating inferiority. Protein may range from 42 per ct. to 46 per ct. or more in good samples. Of 16 samples only two showed evidence of adulteration, but the price did not follow percentage of protein.

Old, or pressure; process linseed meal and new, or naphtha extraction, process meal differ mainly in fat, the former containing three or four pounds more per hundred. Protein of new process meal is perhaps less digestible because of cooking. Nineteen samples were examined and all were good. One was somewhat low in protein with no sign of adulteration.

Gluten meals consist mainly of hard or flinty portions of corn after bran, germ and part of the starch have been removed. They should contain at least 30 per ct. of protein to be classed as meals and may go to 40 per ct. Two samples analyzed were good but the less nitrogenous sold for the higher price.

The gluten feeds are a mixture of the meal with the bran and germs and are less rich in protein than the meals, ranging from 18.8 per ct. to 28.1 per ct. This marked difference seems to be quite constant between the brands, samples of Joliet and Diamond brands running low.

Malt sprouts are the dried shoots from germinated barley. But few samples were analyzed and these were found normal in composition, with from 24.66 per ct. to 30.37 per ct. of protein.

Brewer's grains are the barley grains from which the starch has been removed by growth and fermentation. In fresh state they contain too much water to justify paying a very large price. Dried they furnish about as much protein as the malt sprouts.

Buckwheat middlings and other buckwheat products were found of good quality, but varied widely in protein content, the middlings and feed running from 24.8 per ct. to 33.7 per ct., while the single sample of "ships" showed 33.75 per ct. protein, 9.2 per ct. fat.

Wheat brans were found pure, but not constant in composition, the protein ranging from 13.4 per ct. to 17.1 per ct., and the starch from 17.5 per ct. to 30.6 per ct.

The mixed wheat feeds are combinations of the offals of wheat milling and showed only the natural variations.

Wheat middlings, with one exception, proved normal in composition showing only variations similar to bran and due to same cause, difference in milling processes. Middlings contain more protein, more starch, a little more fat and less fiber than bran and are more digestible. It would seem that preference should not be given the bran as a feed.

Hominy feed or hominy chop consists of the hull, germ and part of the starch of corn grains; and contains less starch, about the same amount of protein and more fiber and fat than corn meal. The samples analyzed appeared quite uniform in composition, except Hudnut's which contained seven per ct. more protein than the average. The average was about 10.5 per ct. protein, 46 per ct. starch and sugar and 7.75 per ct. fat. The prices were much less uniform than the percentages.

In mixed feeds seems to lie the greatest danger from adulteration, a danger which is not entirely guarded against by chemical determination of protein and fat. Oat hulls are extensively used as adulterants in foods of this class. Prices were often equal to what would have bought whole corn and oats. In 26 cases out of 35 examined, the fiber content is larger than the average for whole

oats and much larger than could be given by any straight corn and oats mixture. Some of the feed must have contained at least 50 lbs. of oat hulls per hundred lbs. One oat feed was less digestible by nearly 12 lbs. than whole oats and by nearly 31 lbs. than maize, due largely to the indigestible character of the hulls. The introduction of oat hulls into any mixed feed therefore, increases the amount of indigestible — useless — matter. The material coming from whole grains is also of better quality, being made up more largely of protein and the easily digestible carbohydrates.

Reasons why the source and character of the carbohydrates should be carefully considered in classifying feeding stuffs, are given in full in the bulletin.

Patent foods made up of some simple feed stuff like middlings, corn bran, linseed meal, etc., with a small quantity of charcoal, sulphur, fenugreek, gentian, salt, iron compounds, pepper and other cheap drugs and condiments were found on sale in great numbers and at exorbitant prices, varying from $100 to $500 a ton. This is from $70 to $470 a ton more than the best of them are worth as feeds. Their value as medicines is problematical; if anything, the same effect can be much more cheaply secured by buying the drugs and mixing with the feeds ordinarily used in the stable.

INTRODUCTION.

Commercial cattle foods are an important factor in the animal husbandry of this State. Few farmers, especially dairy farmers, produce all the grain they feed to their stock, for the winter ration generally includes one or more of the by-product feeding stuffs, usually of a more highly nitrogenous character than the home raised grains. Doubtless these purchased materials are often used with profit, while on the other hand, the opinion is freely expressed that it would be economy for many farms to be more fully self-supporting in the matter of the supply of cattle foods. However this may be, it is entirely probable that commercial

feeding stuffs, more particularly those of the highly nitrogenous kinds, will continue to hold their place in the ration, and for this reason it is desirable, even essential, that the purchasers of these commodities shall have an intelligent understanding of their character and value.

It is not surprising that the feeding stuff market is an object of perplexity, as it appears to be, to the majority of would-be buyers. The whole grains as such and as mixed with certain waste products, oil meals, the gluten feeds and meals, breakfast food wastes, brewer's wastes and the so-called patent foods, besides the combination of a variety of materials, good and poor, under the name of "mixed feeds," are all urged upon the attention of the agricultural public. Such a variety of appearance, composition and price must be considered that even the wisest may well hesitate before deciding what articles can be chosen most suitably and economically for a particular use.

In view of the situation as thus outlined, and in order to present certain facts which have been gathered relative to the feeding stuff market in New York, besides paving the way for the largest benefit which may accrue from the new feeding stuff law, it is deemed wise to issue this bulletin. Many of the facts stated are by no means new, and some of the analyses are but a repetition of previous results, yet it is felt that the situation justifies the statement of what is to some extent already familiar knowledge.

INFORMATION WHICH THE BUYER SHOULD POSSESS.

The farmer who wishes to buy a feeding stuff to supplement his home supply of grains should, first of all, understand the general character of any material to which his attention is called, *i. e.*, he should know whether it belongs to the carbohydrate or nitrogenous class of feeding-stuffs.

To the man who is well informed, the trade name is generally indicative of composition. It is true, however, that new materials are constantly appearing in the market and trade names are some-

times deceptive, so that it will be a distinct gain when commercial cattle foods are branded with their real percentages of protein and fat, as presumably will be the case in New York under the operation of the new feeding stuff law.

Moreover, buyers should understand something of the source and general nature of the waste products which make up a large proportion of our commercial feeding stuffs. The fact that any material is an offal from a manufacturing process may or may not mean that it is of inferior nutritive value. As an illustration, certain parts of the maize kernel which appear in the gluten meals and hominy wastes are from the parts of the grain in no way inferior, whereas oat hulls are the least valuable part of the seed. These facts establish an important distinction between the by-products from starch and glucose manufacture and those from the manufacture of breakfast foods from oats. For this and similar reasons, the ingredients of the various mixed feeding stuffs should be clearly stated for the buyer's benefit, and the provision of our new feeding stuff law which, among other things, makes illegal the abominable practice of adulterating corn meal with oat hulls, without the knowledge of the purchaser, to be sold to him as mixed feed from corn and oats, is a step in the direction of enforced honesty in the cattle food trade.

CLASSIFICATION OF FEEDING STUFFS.

Cattle foods are often classified in a popular way as "carbohydrate" and "nitrogenous." Such a division into two classes, based upon the proportions of carbohydrates and protein, is not rational. The fact is, there is a quite uniform gradation in the percentage of protein in feeding stuffs from cotton-seed meal to wheat straw and there seems to be no natural point of separation into two groups. It is absurd to place wheat bran with 16 per ct. of protein in the same group with cotton-seed meal with 45 per ct. of protein.

As a matter of convenience and a nearer approximation to accuracy, it seems advisable to classify feeding stuffs into at least four groups and even with this arrangement the range of composition within any one group is quite wide.

The following are the classes suggested, with some of their principal members:

Class I. 30 to 45 per ct. protein and 50 to 60 per ct. carbohydrates, including cotton-seed meal, linseed meal and the gluten meals, such as the Chicago, King, Cream and Hammond.

Class II. 20 to 30 per ct. protein and 60 to 70 per ct. of carbohydrates, including gluten feeds, such as the Buffalo, Golden, Diamond, Davenport, Climax and Standard, as now made, Atlas meal, dried brewer's grains, malt sprouts, buckwheat middlings and peas and beans.

Class III. 14 to 20 per ct. of protein and 70 to 75 per ct. of carbohydrates, including brans and middlings from wheat and rye, certain so-called mixed feeds of a proprietary character, these being in part oat feeds fortified with some more highly nitrogenous material.

Class IV. 8 to 14 per ct. of protein and 75 to 85 per ct. of carbohydrates, including barley, corn, oats, rye, wheat, cerealine, hominy and oat feeds, corn and oat chop, corn bran, corn germ feed and chop feed in general.

The hays and other fodders belong in Class IV more nearly than in any other.

ANALYSES AND COMMENTS.

THE SAMPLES AND THEIR EXAMINATION.

The samples, the analyses of which appear in this bulletin, were mostly selected in this State during the past two winters by authorized representatives of this Station. In a majority of cases the selling prices are given, these being the ton prices stated to our agent by the dealers where the sample was procured. It is

to be noted that the names of manufacturers are not given in connection with various samples. As many of the goods were not branded by the name of the maker or importer, it was thought best, in order to avoid possible error, to consider the samples wholly from the standpoint of what inspection has shown them to be.

These samples were submitted to more than the usual chemical analysis,— they were carefully examined as to the nature of their constituents, special attention being given to the feeds of a mixed character and to those coming under the head of proprietary or condimental foods.

Moreover, the chemical analysis has been made to include even more than usual. In the case of the mixed and chop feeds the amount of fiber present is often suggestive as to the origin of their constituents and besides it is interesting and useful to know to what extent, especially in the corn and oat offals, the starch and other equally valuable carbohydrates have been removed.

COTTON-SEED MEAL.

This feeding stuff is a by-product of the manufacture of cotton-seed oil. The seed of cotton, after the long fibers are removed by ginning, consists of a kernel enclosed by a thick hull. This hull, after removal, constitutes a low grade feeding stuff which is known in the market as cotton-seed hulls. The hulled kernels are crushed and after they are cooked the oil is removed by pressure, leaving a cake residue, nearly 800 pounds from a ton of seed, which after grinding we know as cotton-seed meal. The color of this meal should be light yellow and it should have a clean nutty flavor. The percentage of protein in the best product generally ranges between 42 per ct. and 46 per ct. Among the causes of inferiority are the presence of hulls and injury due to fermentations, but these conditions are indicated by the color and flavor. Dark colored cotton-seed meal should be regarded with suspicion.

SAMPLES OF COTTON-SEED MEAL COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price	Station number	Sample: Where collected.	Ton selling price.
438..	Elmira	$23 00	553..	Florida	$22 00
439..	Elmira	24 00	656..	Sidney	18 00
465..	Buffalo	28 00	660..	Delhi	23 00
487..	Syracuse	28 00	672..	Hobart	23 00
490..	Syracuse	23 00	673..	Hobart	22 00
500..	Oswego	23 00	692..	Middlebury	......
518..	Utica	23 00	705..	......	......
545..	Middletown	......	706..	......	......
552..	Florida	11 00			

ANALYSES OF SAMPLES OF COTTON-SEED MEAL.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
438.	Cotton-seed meal	5.10	6.51	46.75	5.07	13.2	23.78	12.79
439.	Cotton-seed meal	7.42	8.15	36.25	5.29	24.7	34.74	8.15
465.	Cotton-seed meal	7.05	6.00	42.25	5.20	20.1	29.62	9.88
487.	Cotton-seed meal	6.35	6.86	46.00	6.10	14.3	25.99	8.70
490.	Cotton-seed meal	7.18	6.54	43.56	7.30	15.4	27.86	7.56
500.	Cotton-seed meal	7.11	6.19	41.68	6.82	12.7	26.28	11.92
518.	Cotton-seed meal	7.05	6.02	48.81	4.68	16.4	24.59	8.85
545.	Cotton-seed meal	7.40	5.98	46.56	5.08	13.7	25.71	9.27
552.	Cotton-seed feed	7.81	3.63	10.75	33.37	6.6	42.03	2.41
553.	Cotton-seed meal	6.24	5.90	50.69	2.92	13.7	23.82	10.43
656.	Cotton-seed meal	6.94	6.00	43.75	5.81	....	23.24	14.26
660.	Cotton-seed meal	7.77	6.85	45.50	4.27	....	25.56	10.05
672.	Cotton-seed meal	7.21	5.69	49.06	4.68	....	22.33	11.03
673.	Cotton-seed meal	7.01	5.92	44.38	5.59	....	23.94	13.16
692.	Cotton-seed meal	7.14	5.90	43.43	7.24	....	23.51	12.78
705.	Cotton-seed meal	7.45	5.39	28.68	16.57	....	34.62	7.29
706.	Cotton-seed meal	6.19	6.50	46.56	5.38	....	24.49	10.88
	Average all but 439, 552 and 705	6.84	6.21	45.64	5.44	....	25.05	10.82
	Average starch and sugar, eight samples.	....	....	.....	.....	14.9	.....	.....

In all but two cases the samples of cotton-seed meal have been found to have a satisfactory composition. Two samples, Nos. 439 and 705, showed so low a protein content as to justify the conclusion that they were from adulterated stock. They were dark colored. There is no question that adulterated meal is in the market, as is clearly proven in Bulletin No. 56 from the Massachusetts Experiment Station, where the analyses are given of

eighteen samples of inferior goods found in the market of that State.

This adulteration is probably brought about by grinding in hulls. These meals were sold in part under the name Sea Island Cotton-seed and probably were in all cases a mixture of the yellow meal and finely ground hulls. Farmers should avoid such goods.

The sample of cotton-seed feed No. 552, the analysis of which appears in the above table as a means of contrasting it with cotton-seed meal, consists of cotton-seed hulls and is very inferior in value.

LINSEED MEAL.

Linseed meal is a by-product from the manufacture of linseed oil. It is often called oil meal. "Old process" oil meal is that from which the oil is obtained by pressure and "new process" meal is the residue afer treating the crushed seed with a light naphtha. The former contains the more fat although owing to a change in the process the "old process" meal contains less fat than was formerly the case.

By the older methods about 35 lbs. of oil was obtained from 100 lbs. of seed, but now the output is larger.

The relative value of "old process" and "new process" meal is much discussed. Certainly there is no appreciable difference in palatableness and healthfulness, and no large difference in nutritive qualities. The protein of the latter appears to be somewhat less digestible, due doubtless to the increased cooking to which the new process product is subjected.

SAMPLES OF LINSEED MEAL COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price.	Station number.	Sample: Where collected.	Ton selling price.
428..	Union Springs	......	498..	Fulton	$25 00
435..	Fayetteville	......	501..	Oswego	25 00
436..	Elmira	$28 00	514..	Watertown	25 00
440..	Elmira	30 00	517..	Utica	28 00
443..	Corning	30 00	529..	Binghamton	28 00
455..	Hornellsville	30 00	670..	Hobart	30 00
464..	Buffalo	30 00	694..	Cobleskill	......
471..	Waterloo	28 00	698..	Otego	30 00
481..	Geneva	27 00	699..	Otego	30 00
491..	Syracuse	30 00			

ANALYSES OF SAMPLES OF LINSEED MEAL.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
428.	Linseed meal, old process.	8.87	5.51	37.25	7.29	10.1	34.64	6.44
435.	Linseed meal, old process.	6.84	5.35	37.25	7.43	7.4	36.21	6.92
436.	Linseed meal, old process.	8.68	5.45	38.06	7.38	9.4	34.31	6.12
440.	Linseed meal, old process.	8.34	5.39	35.00	8.55	15.0	35.40	7.32
443.	Linseed meal, old process.	8.53	5.14	36.31	7.60	12.2	36.48	5.94
455.	Linseed meal, old process, Buffalo	8.03	5.35	36.69	6.94	11.6	35.53	7.46
464.	Linseed meal, old process.	8.97	4.85	35.81	7.10	10.4	35.76	7.51
471.	Linseed meal, old process.	8.10	4.86	36.06	6.82	11.4	35.67	8.49
481.	Linseed meal, old process, National	7.75	5.82	35.81	7.54	7.5	36.17	6.91
491.	Linseed meal, old process.	7.37	5.29	36.94	7.43	11.4	36.04	6.93
501.	Linseed meal, old process.	9.43	5.51	28.69	8.59	22.7	40.15	7.63
517.	Linseed meal, old process.	8.45	5.31	36.19	7.03	13.9	34.16	8.86
529.	Linseed meal, old process, Empire	6.89	5.22	38.19	7.11	14.8	36.87	5.72
699.	Linseed meal, old process.	9.76	5.37	32.13	8.16	....	36.12	8.46
	Average	8.29	5.32	35.74	7.50	12.1	35.96	7.19
498.	Linseed meal, new process, Cleveland	10.53	5.01	36.63	8.69	18.4	36.23	2.91
514.	Linseed meal, new process.	10.08	4.95	37.56	7.22	19.1	37.04	3.15
670.	Linseed meal, new process.	10.25	5.33	35.81	8.57	....	35.99	4.05
694.	Linseed meal, new process, Cleveland	9.87	5.36	35.19	8.48	....	36.31	4.79
698.	Linseed meal, new process.	9.34	5.50	35.50	9.08	....	37.62	2.96
	Average	10.01	5.23	36.14	8.41	18.7	36.64	3.57

The linseed meal found in New York seems to be quite uniformly good. This appears to be the case in all States. Adulteration of this feeding stuff is evidently not much practiced. Sample No. 501 contains less protein than it should, but no explanation of this fact was discovered. Linseed meal is certainly one of our most valuable and reliable commercial feeding stuffs, though it is evidently expensive as compared with some other articles.

GLUTEN MEALS.

As found in the market the principal gluten products are corn bran, consisting mostly of the hulls and germ of the maize kernel, the gluten meals which come principally from the hard or flinty

portions of this seed and the gluten feeds which are a mixture of the corn bran and gluten meal. Of these the gluten meals are the most valuable. They contain between 30 and 40 per ct. of protein and are practically as digestible as corn meal.

SAMPLES OF GLUTEN MEAL COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price.
494..	Syracuse	$18 00
658..	Sydney Center	20 00

ANALYSES OF SAMPLES OF GLUTEN MEAL.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
494.	Gluten "M"	6.51	1.65	39.08	1.50	35.7	46.56	4.7
658.	Chicago gluten meal	10.0	.84	36.25	1.92	....	48.60	2.39

The above samples of gluten meal are fully up to the standard, No. 494 being especially rich in protein.

GLUTEN FEEDS.

As previously stated, gluten feeds are a mixture of all the by-products which are left after removing a portion of the starch from the maize kernel. They contain less protein than the gluten meals and much more than the corn brans.

SAMPLES OF GLUTEN FEEDS COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price.
422..	Union Springs	......
427..	Dryden	$16 00
521..	Norwich	17 00
525..	Sidney	17 00
527..	Sidney	17 50
688..	Albany	......
496..	Syracuse	15 00
543..	Middletown	......
555..	Florida	17 00
437..	Elmira	14 00
536..	Whitney's Point	......
418..	Geneva	......
479..	Geneva	$16 50
495..	Syracuse	16 00
424..	Dryden	13 00
533..	Binghampton	18 00
531..	Binghampton	17 75
743..	Syracuse	......
508..	Pulaski	18 00
535..	Whitney's Point	18 00

ANALYSES OF SAMPLES OF GLUTEN FEEDS.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Ether extract.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
422.	Buffalo gluten feed	8.66	3.53	27.19	6.71	21.9	50.09	3.82
427.	Buffalo gluten feed	8.15	4.10	27.63	6.18	21.2	49.27	4.67
521.	Buffalo gluten feed	9.14	3.02	27.06	7.00	21.5	50.40	3.38
525.	Buffalo gluten feed	7.66	3.01	26.06	2.46	26.5	57.43	3.38
527.	Buffalo gluten feed	8.62	0.84	21.31	6.24	34.0	59.46	3.53
688.	Buffalo gluten feed	6.87	2.70	27.38	6.76	....	52.81	3.48
	Average	8.18	2.87	26.10	5.89	25.0	53.25	3.71
496.	Climax gluten feed......	7.95	0.94	24.56	1.31	26.5	60.43	4.81
543.	Davénport gluten feed...	7.56	1.11	23.56	6.83	26.2	55.46	5.48
555.	Davenport corn feed.....	8.07	1.23	22.94	6.33	28.8	56.75	4.68
	Average	7.82	1.17	23.25	6.58	27.5	56.10	5.08
437.	Diamond gluten feed....	7.74	7.90	20.56	6.06	28.8	54.34	3.40
536.	Diamond gluten feed....	8.17	0.83	20.00	6.51	29.4	59.28	5.21
	Average	7.96	4.36	20.28	6.29	29.1	56.81	4.30
418.	Joliet gluten feed	8.82	0.92	18.80	6.58	32.2	60.39	4.49
479.	Joliet gluten feed	7.80	0.87	19.56	6.43	30.2	60.66	4.68
	Average	8.31	.90	19.18	6.50	31.2	60.52	4.59
495.	"R" gluten feed........	7.68	1.13	28.13	4.50	36.3	54.88	3.68
424.	Peoria gluten feed	8.38	0.97	20.69	5.87	27.7	57.05	7.04
533.	Peoria gluten feed	8.65	2.04	26.00	7.10	25.1	52.41	3.80
	Average	8.51	1.50	23.34	6.98	26.4	54.73	5.42
531.	Empire gluten feed......	8.01	1.11	24.43	7.21	16.7	53.85	5.39
743.	Waukegan gluten feed...	6.19	1.03	24.31	7.48	....	56.34	4.65
508.	Gluten feed	7.58	.93	21.50	5.66	26.9	57.55	6.78
535.	Gluten feed	8.26	.91	23:37	6.05	31.	56.81	4.60
	Average of all analyses.	8.00	1.96	23.75	5.99	27.3	55.75	4.55

The above named materials, all of which pass under the name of "gluten feeds," show a range of protein content from 18.8 per ct. to 28.1 per ct. These differences appear to pertain more largely to brands than to samples, the Joliet and Diamond brands falling considerably below the others in protein content. However this may be, the facts as given are a good illustration of the need of branding commercial feeding stuffs with a statement of their composition, for unless this is done a gluten feed passes for such without the buyer having a definite knowledge of what it really is, and besides, this class of materials is often confounded with gluten meals which are of superior value, both as to composition and digestibility.

BREWER'S AND DISTILLERY RESIDUES.

The so-called brewer's residues are those resulting from the operations of malting and brewing.

In malting, the barley grains are allowed to sprout, and before the malted grains are crushed for brewing purposes these sprouts are removed, which in an air dry condition are known in the market as malt sprouts.

From the malted grains is extracted the sugar that has formed from the starch during the germination which has occurred, and these extracted grains after drying appear in the market as dried brewer's grains. They are much poorer in starch and richer in protein than the entire barley grain and are properly regarded as a nitrogenous feeding stuff.

SAMPLES OF BREWER'S RESIDUES COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price.	Station number.	Sample: Where collected.	Ton selling price.
489..	Syracuse	$10 00	1258..	Syracuse	......
504..	Oswego	12 00	1259..	Syracuse	......
538..	Geneva	12 00	724..	Waterloo	......

ANALYSES OF SAMPLES OF BREWER'S RESIDUES.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
489.	Malt sprouts	6.00	5.73	24.66	13.29	22.3	47.32	3.00
504.	Malt sprouts	3.26	7.62	30.37	9.14	21.4	47.17	2.44
538.	Malt sprouts	5.88	5.86	27.69	10.34	21.9	46.72	3.51
	Averages	5.05	6.40	27.58	10.93	....	47.06	2.98
	Average starch and sugar	.....	....	.....	.....	21.9	.....	.....
1258.	Brewer's grains, lager, fresh	77.0	0.66	6.99	2.90	....	11.01	1.44
	Brewer's grains, lager, air dry	6.95	2.69	28.31	11.75	....	44.46	5.84
1259.	Brewer's grains, ale, fresh	78.8	0.68	5.45	3.19	....	10.43	1.45
	Brewer's grains, ale, air dry	6.34	3.02	24.13	14.14	....	45.95	6.42
724.	Distillery waste, fresh.	91.3	0.32	2.98	0.84	....	3.45	1.11
	Distillery waste, air dry	6.46	3.39	32.0	9.03	....	37.20	11.92

Not many samples of brewer's wastes were obtained, and those which were analyzed were not unusual in composition.

But few analyses have been made in this country of distillery waste. No. 724 was obtained from a distillery at Waterloo and in the fresh condition is somewhat used by farmers in the immediate vicinity. It is to be noted that the proportion of dry matter in the fresh material is very small, only 8.7 per ct. or one-tenth as much as in the ordinary grains in an air dry condition. The cost should be only one-tenth also. This observation applies in a general way to the fresh brewer's grains which proved to be nearly three-quarters water.

BUCKWHEAT MIDDLINGS.

There are several offals from the milling of buckwheat, including the hulls, the bran and middlings. The latter contain a generous proportion of protein, usually not less than twenty-five, and they are properly classed among our nitrogenous feeding stuffs. Oftentimes the bran and middlings are mixed together when the percentage of protein is reduced in proportion to the

amount of bran present. The bran contains from 10 per ct. to 12 per ct. of protein and the hulls from 3 per ct. to 5 per ct.

SAMPLES OF BUCKWHEAT MIDDLINGS COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price.	Station number.	Sample: Where collected.	Ton selling price.
426..	Smithboro	$13 00	659..	Delhi	$16 00
433..	Hornellsville	14 00	728..	Lawyersville	......
499..	Fulton	14 00	696..	Oneonta	13 00
511..	Watertown	14 00	510..	Watertown	14 00
530..	Binghamton	14 00			

ANALYSES OF SAMPLES OF BUCKWHEAT MIDDLINGS.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct	Per ct.	Per ct	Per ct.	Per ct.	Per ct.	Per ct.
426.	Buckwheat middlings...	10.39	4.24	27.25	5.73	21.9	45.06	7.33
453.	Buckwheat middlings...	11.14	5.01	27.38	5.55	30.3	43.29	7.63
499.	Buckwheat middlings...	9.90	5.14	30.31	7.68	17.4	38.96	8.01
511.	Buckwheat middlings...	12.77	4.29	26.44	2.75	24.2	46.87	6.88
530.	Buckwheat middlings...	11.30	4.50	24.81	4.29	35.8	48.55	6.55
728.	Buckwheat middlings...	13.40	4.65	25.31	9.42	....	41.05	6.17
696.	Buckwheat, "feed"....	11.50	4.85	26.38	12.91	....	37.75	6.60
510.	Buckwheat, "ships" ...	12.19	5.78	33.75	4.78	15.6	34.30	9.20
	Averages	11.56	4.81	27.70	6.64	....	41.99	7.30
	Average starch and sugar, 6 samples...	.....	....	.....	.....	24.2	.....	....

No one of the lots of buckwheat middlings sampled seems to have been of inferior quality. There is seen to be a wide variation in the protein content, however, as it ranges from 24.8 per ct. to 33.75 per ct. in the various samples.

MILLING OFFALS FROM WHEAT.

The offals from milling wheat are probably the oldest, best known and most popular by-product feeding stuffs found in the market. These consist of the brans, middlings and low grade flours.

The prominent differences between these products and the original wheat kernels, and especially between these and the fine

flour designed for human consumption, are the larger proportions in them of mineral matter and protein. This is due to the fact that these by-products consist of the outer portions of the wheat kernel which are relatively rich in mineral and nitrogen compounds.

SAMPLES OF WHEAT BRAN COLLECTED IN NEW YORK IN 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price.	Station number.	Sample: Where collected.	Ton selling price.
429..	Victor	......	478..	Geneva	$16 00
430..	Dryden	$13 50	484..	Auburn	15 00
434..	Delhi	......	519..	Utica	15 00
442..	Corning	15 00	549..	Florida	15 50
449..	Hornellsville	14 00	551..	Florida	16 00
468..	Rochester	14 50	682..	New Paltz	16 00

ANALYSES OF SAMPLES OF WHEAT BRAN.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
429.	Wheat bran, spring	9.15	6.18	16.37	10.20	18.2	52.99	5.11
430.	Wheat bran	8.96	5.81	16.37	10.32	18.5	53.45	5.09
434.	Wheat bran	8.66	4.63	13.37	13.64	22.9	56.30	3.40
442.	Wheat bran	8.63	4.45	16.00	10.11	17.5	55.22	5.59
449.	Wheat bran, western	9.02	6.84	17.13	9.32	20.1	52.05	5.64
468.	Wheat bran	9.27	6.43	15.94	9.37	19.7	53.99	5.00
478.	Wheat bran	7.81	5.15	15.25	7.13	30.6	60.28	4.38
484.	Wheat bran	10.67	4.82	14.94	7.52	26.8	56.58	5.47
519.	Wheat bran, spring	10.71	6.52	16.06	8.86	20.0	52.62	5.23
549.	Wheat bran	9.29	6.84	13.75	9.35	19.4	55.87	4.90
682.	Wheat bran	11.35	3.45	13.75	5.67	....	62.19	3.59
	Average of 12 samples wheat bran	9.49	5.47	15.36	8.94	....	55.95	4.79
	Average starch and sugar, 11 samples	.....	....	.....	.....	22.8	.....	....

As a rule the wheat brans which have been sampled have been found to be a pure wheat offal. They are seen to vary somewhat in composition, the protein in 12 cases ranging from 13.4 per ct. to 17.1 per ct. The starch content is also far from constant, the extreme percentages being 17.5 per ct. and 30.6 per ct. These variations are doubtless due to differences in the composition of the wheat and to unlike conditions of milling. On the whole,

however, wheat bran is one of our most reliable commercial feeding stuffs.

SAMPLES OF MIXED WHEAT OFFALS COLLECTED IN NEW YORK IN 1898 AND 1899.

Station number.	Sample: Where collected.	Ton selling price.	Station number.	Sample: Where collected.	Ton selling price.
551..	Florida	$16 00	685..	Weldon	$16 00
431..	Dryden	14 50	653..	Sidney	18 00
700..	Otego	18 00	676..	Kingston	18 00
655..	Sidney	......	687..	Walkill	18 00

ANALYSES OF SAMPLES OF MIXED WHEAT OFFALS.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
551.	Ship stuff	10.34	4.50	15.31	5.74	37.4	59.99	4.12
431.	Royal wheat feed	8.88	5.04	17.94	7.73	29.3	55.17	5.24
700.	Royal wheat feed	10.57	4.95	16.56	9.28	....	53.64	5.00
655.	Buckeye wheat feed	10.77	5.13	15.38	7.62	....	55.98	5.12
685.	King winter wheat feed.	10.18	6.27	16.63	7.40	....	54.77	4.75
653.	New Eng. mixed feed	9.88	5.04	15.69	8.13	....	55.67	5.59
676.	Mixed feed	10.76	5.25	15.	7.26	....	56.96	4.77
687.	Mixed feed	10.94	4.89	16.13	8.09	....	54.90	5.05

Many millers are not separating the various wheat offals, but are running them together and are selling the mixture under the term "mixed feed" or some proprietary name. The above figures show a composition such as we would expect these mixtures to have.

SAMPLES OF WHEAT MIDDLINGS COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Samples: Where collected.	Ton selling price.	Station number.	Samples: Where collected.	Ton selling price.
421..	Union Springs	......	671..	Hobart	$19 00
423..	Dryden	$14 50	675..	Kingston	18 00
441..	Corning	16 00	678..	Kingston	18 00
452..	Hornellsville	14 00	680..	Kingston	19 00
469..	Rochester	......	683..	....	......
477..	Geneva	16 00	684..	New Paltz	......
483..	Auburn	16 00	689..	Albany	20 00
515..	Watertown	16 00	693..	Cobleskill	19 00
516..	Watertown	18 00	701..	Union	19 00

ANALYSES OF SAMPLES OF WHEAT MIDDLINGS.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Ether extract.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct	Per ct.	Per ct.
421.	Middlings	9.77	3.78	18.75	6.07	32.5	55.54	6.09
423.	Middlings, Pillsbury's brown	8.62	5.10	17.43	10.05	21.2	53.12	5.68
441.	Middlings	10.69	3.47	17.06	3.45	42.9	60.58	4.75
452.	Middlings, Minn. hard red	9.97	5.00	18.13	7.58	22.5	53.19	6.13
469.	Middlings, winter wheat.	8.56	4.88	19.50	5.71	29.0	54.29	7.06
477.	Middlings, western	9.66	3.23	15.94	3.95	44.9	62.00	5.23
483.	Middlings, winter wheat.	11.41	2.52	14.81	2.60	53.2	64.76	3.90
515.	Middlings, western	10.08	4.51	16.06	5.59	33.3	59.18	4.58
516.	Middlings, red dog	9.44	3.60	20.68	2.45	35.7	58.53	5.30
671.	Middlings, red dog	9.52	2.70	10.81	4.27	....	64.19	8.51
675.	Middlings	10.39	4.86	17.63	7.20	....	54.55	5.37
678.	Middlings, daisy b.	10.78	4.86	18.25	7.44	....	53.23	5.44
680.	Middlings, Adrian	10.61	2.74	20.06	2.17	....	59.19	5.23
683.	Middlings	10.10	4.08	17.19	6.34	....	56.22	6.07
684.	Middlings	9.94	4.48	19.81	5.92	....	53.63	6.22
689.	Middlings	10.14	4.10	18.00	5.66	....	56.50	5.60
693.	Middlings, shorts	10.71	2.97	17.88	3.57	....	59.43	5.44
701.	Middlings	9.63	2.39	15.31	2.64	....	66.25	3.78
	Averages	10.00	3.85	17.41	5.15	....	58.01	5.58
	Average starch and sugar, 9 samples	.....	....	.....	.....	35.0	.....	....

With the exception of sample No. 671, the composition of the middlings does not exhibit any unusual variations. The explanation of the variations which occur in bran apply equally to middlings. The latter appear to be fully the equal of the former in uniformity and reliability. The middlings as found in New York seem to differ from the brans in containing on the average materially more protein, and as is to be expected, more starch, the proportion of fiber being less. Digestion experiments, so far conducted, leave no doubt as to the greater digestibility of the middlings, a conclusion which is entirely consistent with related facts. Why, then, bran should be an apparently more popular dairy feeding stuff than middlings is not clear. There are substantial reasons for believing that the popular judgment is in error, a statement which is worthy the attention of dairymen.

It is recognized, of course, that so-called middlings are sometimes a catch-all for inferior refuse materials, and if this condition of affairs is found to be prevalent in New York it may be necessary

to bring these goods under the provisions of the feeding stuff law, in order that they may be inspected.

HOMINY FEED OR CHOP.

The hominy which is manufactured for human consumption consists of the hard part of the maize kernel. The hull and germ together with more or less of the starchy portions of the kernel make up the waste of hominy manufacture, and are known as hominy feed or chop.

This material differs somewhat from corn meal in composition, the starch being less, the fiber and fat somewhat more, and the protein about the same, yet nutritively speaking, corn meal and hominy feed are not greatly unlike.

Moreover, hominy feed appears to be quite uniform in composition, as is shown by the analyses which are given in this connection.

SAMPLES OF HOMINY FEEDS COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Samples: Where collected.	Ton selling price.	Station number.	Samples: Where collected.	Ton selling price.
523..	Norwich	$16 00	546..	Middletown	......
526..	Sidney	......	550..	Florida	$14 50
528..	Sidney	15 00	652..	Sidney	19 00
534..	Whitney's Point	16 50	669..	Delhi	18 00
537..	Geneva	14 00	674..	Hobart	20 00

ANALYSES OF SAMPLES OF HOMINY FEED.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
523.	Hominy feed	6.13	3.11	10.94	4.59	41.7	66.31	8.92
526.	Hominy feed	7.76	3.03	10.75	4.42	42.9	64.63	9.41
528.	Hominy feed	6.60	2.44	10.38	3.44	52.9	70.47	6.67
534.	Hominy feed	9.70	2.32	10.25	3.63	50.8	67.27	6.83
537.	Hominy feed	10.56	2.26	10.37	4.35	45.8	65.88	6.58
546.	Hominy feed	8.71	2.48	10.63	3.85	45.1	66.90	7.43
550.	Hominy meal	8.28	2.77	10.81	4.43	42.9	65.27	8.44
652.	Hominy feed	10.19	2.47	10.69	3.80	....	64.52	8.33
669.	Hominy, Hudnut's	10.28	3.37	17.69	4.83	....	58.09	5.74
674.	Hominy feed	10.14	2.88	10.56	4.64	....	62.85	8.93
	Averages, excluding No. 669	8.83	2.71	10.60	4.20	....	65.22	7.73
	Average starch and sugar, 7 samples	.....	....	.....	....	46.0	.....	....

MIXED FEEDS.

There has appeared in the feeding stuff trade during recent years a class of materials which, as a rule, are mixtures either of some cereal grain with certain manufacturers' by-products or of two or more by-products. To these are applied a variety of names, often of a proprietary character, some of which give no hint of the nature of the mixture, and others, if taken for their face value, indicate the sources of the ingredients. If these mixtures were always made up wholly of high grade materials, they would need less attention than they now really demand. As a matter of fact, many of them are found to contain a constituent of very inferior value, viz.: oat hulls, a by-product from the manufacture of breakfast foods. Not only have large manufacturing establishments used these hulls in compounding mixtures, but some local millers in the State of New York have bought them to grind with corn and sometimes with mill wastes, the mixed product being sold as "mixed feed," "corn and oat feed," "chop feed," and so on. To quite an extent, at least, farmers have been ignorant of the real nature of these feeds, and as this Station has abundant evidence, have paid for them prices equal to the cost of whole corn and oats. If our millers have been aware of the inferiority of oat hull mixtures, and have sold such goods to consumers who were ignorant of what they were buying, it is charitable to say no more than that the rules of an honorable business policy have been severely violated.

In order that there may be no misapprehension as to the real character of oat hulls, attention is called to their composition and their relation to the kernel.

It was found at the Ohio Experiment Station that with 69 varieties of oats the hull constituted from 24.6 per ct. to 35.2 per ct. of the weight of the grain, the average being 30 per ct. From other sources we learn what is the composition of the dry matter of the whole grain, the hulls and the hull-less kernels.

ANALYSES OF OATS, OAT HULLS AND OAT KERNELS.

	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Whole grain, 30 samples	3.4	13.2	10.8	67.0	5.6
Hulls, 3 samples	7.3	3.4	37.2	50.8	1.3
Hulled kernels, 179 samples	2.3	15.4	1.5	72.1	8.7

The lesson to be drawn from these figures is clear, which is that oat hulls are the inferior portion of the grain. They have but little protein and a large proportion of woody fiber, nearly as much as oat straw. The kernels are the easily digestible and nutritious portion of the oat grains and are surrounded by the tough, woody hulls, which in whatever light we regard them can hardly have a greater value for feeding purposes than straws. Below can be seen the prices and composition of a considerable number of these mixed feeds, not all of which, however, contain oat offals.

SAMPLES OF VARIOUS OAT FEEDS AND MIXED FEEDS, PROPRIETARY AND OTHERWISE, COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Selling price.	Station number.	Sample: Where collected.	Selling price.
425..	Smithboro	......	472..	Geneva	$20 00
649..	Binghamton	$20 00	480..	Geneva	15 00
433..	Smithboro	......	482..	Auburn	19 00
679..	Kingston	20 00	492..	Syracuse	16 00
466..	Buffalo	16 00	497..	Fulton	25 00
467..	....	......	548..	Syracuse	15 00
540..	Buffalo	15 00	677..	Kingston	17 50
419..	Union Springs	......	695..	Oneonta	18 00
473..	Geneva	15 00	697..	Oneonta	18 00
507..	Pulaski	15 00	703..	Owego	19 00
681..	New Paltz	16 00	704..	....	......
503..	Oswego	15 00	542..	Middletown	......
654..	Sidney	20 00	648..	Binghamton	20 00
668..	Delhi	16 00	554..	Florida	12 00
432..	Victor	......	657..	Sidney Center	19 00
544..	Middletown	......	420..	Union Springs	......
444..	Corning	16 00	650..	Binghamton	16 00
447..	Corning	15 00			

ANALYSES OF SAMPLES OF VARIOUS OAT FEEDS, AND MIXED FEEDS, PROPRIETARY AND OTHERWISE.

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
425.	H. O. stand. dairy food.	8.41	3.14	17.50	10.43	31.7	55.31	5.21
649.	H. O. stand. dairy food.	7.92	3.49	16.31	12.59	....	55.40	4.29
	Average	8.17	3.31	16.90	11.51	....	55.36	4.75
433.	H. O. stand. horse food.	8.64	3.37	11.69	10.26	36.7	62.35	3.69
679.	H. O. stand. horse food.	9.27	3.29	10.69	11.00	....	61.49	4.26
	Average	8.96	3.33	11.19	10.63	....	61.92	3.97
466.	H. O. feed	9.40	3.53	13.05	9.86	38.5	60.31	3.85
467.	H. O. feed	9.28	3.41	9.19	10.23	39.0	63.54	4.35
540.	H. O. feed	8.55	3.32	12.50	10.87	38.3	61.21	3.55
	Average	9.08	3.42	11.58	10.32	38.6	61.68	3.92
419.	Quaker oat feed	8.10	5.17	11.31	16.33	26.5	55.40	3.69
473.	Quaker oat feed	6.20	5.33	10.69	17.29	25.6	57.08	3.41
507.	Quaker oat feed	7.96	4.85	9.31	16.66	29.5	58.23	2.99
681.	Quaker oat feed	7.23	5.30	11.50	15.27	....	56.57	4.13
	Average	7.37	5.16	10.70	16.39	27.2	56.82	3.56
503.	Victor feed	9.49	3.43	8.56	10.78	38.9	63.63	4.11
654.	Victor corn and oats....	9.17	3.43	8.25	11.56	....	64.05	3.54
668.	Victor corn and oats....	8.94	3.60	7.63	12.20	....	64.60	3.03
	Average	9.20	3.49	8.15	11.51	....	64.09	3.56
432.	Corn and oat feed	8.18	3.35	9.37	9.84	42.1	64.93	4.33
544.	Corn and oat feed	9.91	3.08	7.56	11.71	35.2	64.28	3.46
	Average	9.04	3.22	8.46	10.78	38.6	64.61	3.89
444.	Chop feed	9.92	2.73	8.44	6.56	44.1	68.25	4.10
447.	Chop feed	9.14	3.57	8.50	10.97	38.9	63.92	3.90
472.	Chop feed	11.03	2.65	14.19	6.76	37.9	61.75	3.62

ANALYSES OF SAMPLES — *Continued.*

Station number.		Water.	Ash.	Protein.	Fiber.	Starch and sugar.	Total nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
480.	Chop feed	13.04	2.17	11.38	4.72	42.5	65.31	3.38
482.	Chop feed	10.99	2.06	10.44	5.57	40.6	66.56	4.38
492.	Chop feed	9.11	2.93	7.81	8.84	43.7	67.92	3.39
497.	Chop feed	11.30	1.92	9.81	5.51	51.2	66.90	4.56
548.	Chop feed	8.97	2.85	8.63	8.13	42.8	68.07	3.35
677.	Chop feed	11.38	3.32	6.56	12.82	....	64.63	1.29
695.	Chop feed	9.92	3.59	7.19	14.16	....	62.46	2.68
697.	Chop feed	9.07	3.57	8.63	12.18	....	62.80	3.75
703.	Chop feed	10.14	1.19	8.13	11.44	....	61.98	5.12
704.	Chop feed	8.60	3.07	8.56	9.71	....	66.62	3.44
542.	Chop feed oats	5.34	6.43	4.56	29.74	8.7	52.26	1.67
	Average of chop feed, excluding last analysis	10.06	2.81	9.23	9.27	42.7	64.84	3.79
648.	H. O. defi. feed	8.54	3.91	8.50	14.78	....	61.25	3.02
554.	X oat feed	6.72	6.15	6.31	24.31	15.0	54.02	2.49
657.	Schumaker's stock food, corn, oats and barley	8.83	3.41	12.69	7.53	....	62.48	5.06
420.	Corn, oat and barley feed	9.09	1.47	11.19	9.93	36.7	63.95	4.37
650.	Wheat feed	9.22	4.04	11.00	16.56	....	56.09	3.09

It is important to properly interpret the facts displayed in the above tables in their practical relations to the stockman. It is to be noted in the first place that the prices of these various mixed feeds are in many cases fully equal to what a mixture of whole corn and oats would have cost at the time the samples were taken. This being so, it is fair to inquire whether the by-product combinations of the class we are discussing are equal in value to the entire cereal grains. The principal fact to be considered in this connection is that nearly all of the feeds mentioned above contain a generous proportion of oat offals, largely hulls. This is shown in two ways, viz.: by the high proportion of woody fiber and by the low protein content. Oats contain more fiber than any other

cereal grain except buckwheat, the average percentage in thirty samples of American oats being 9.5 per ct.

In 26 cases out of 34 the fiber content of these mixtures, as shown above, is larger than that in average oats and in 16 instances it ranges between 11.0 and 29.7 per ct. Moreover, a majority of these feeds contain quite a proportion of corn, or perhaps hominy waste, material, which has a very low fiber content, averaging not over 2 per ct. It is clear that a mixture of the entire grains of corn and oats which does not carry less fiber than the oats, is impossible, and inversely it is equally plain that combinations of corn and of oat offals with as large and generally much larger, percentage of fiber than is found in pure oats must contain more oat hulls than belong with the oat kernels present, That this is true of many of these feeding stuff mixtures is shown by a mere mechanical examination without resorting to a chemical analysis. Some of them must contain not less than 50 lbs. of oat hulls per hundred pounds. The low proportion of protein is also evidence of a convincing character. In 20 out of the 34 samples, the protein content is below what would ever be the case with a mixture of whole corn and oats, a condition which is brought about by the small proportion of protein in the oat hulls present.

In certain brands an amount of some highly nitrogenous feeding stuff like cotton-seed meal or gluten meal is found, the object of its use being to bring up the protein content to the standard of wheat bran. This certainly improves the feed, but at the same time the presence of high quality ingredients adds nothing to the value of the inferior constituents. Grinding corn with oat hulls, for instance, may not injure the corn but it does not improve the hulls. They are still hulls and retain all their characteristics as a feeding stuff.

In order to ascertain the effect upon digestibility of introducing oat feed into a feeding stuff mixture, an experiment has been conducted at this Station with sheep, using as the experimental feed-

ing stuff an oat feed sold in the State of New York. The results were as follows:

DIGESTION EXPERIMENT WITH OAT FEED.

ANIMALS.	Digestion Coefficients.					
	Dry matter.	Organic matter.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct
Sheep No. 3	59	60	81	37	61	92
Sheep No. 4	57	59	84	31	60	92
Average for oat feed	58	59.5	82.5	33	60.5	92
Average for whole oats, German trials	...	71.4	78	25.6	76.8	83.5
Average for maize kernels	...	90.7	76	58	93.3	85.5

The organic matter represents the total amount (ash excepted) of nutritive compounds which are utilized by an animal in maintaining and building the body and it appears that the whole oats furnish about 12 lbs. and maize 31 lbs. more of this per hundred than the oat feed. Besides, the material coming from the entire grains is of better quality, being made up more largely of protein and the easily digestible carbohydrates.

THE CARBOHYDRATES OF MIXED FEEDS AND OTHER FEEDING STUFFS.

The superiority of the dry matter of the cereal grains over that of the coarse fodders is generally recognized. This fact is due to two causes, viz: (1) The greater extent and (2) the greater ease of digestion of the grains as compared with the fodders. In this connection the carbohydrates are of first importance, in point of quantity at least. These compounds differ among themselves in their digestibility to a marked extent. The sugars and starches, under normal conditions are promptly and completely digested, while the gums, fiber and other less well known substances are

only partially dissolved in the digestive juices. It follows, then, other things being equal, that the larger the proportion of starch and sugar in the nitrogen-free extract of a feeding stuff the more completely is it digested.

It also follows that when any manufacturing or other process reduces the proportion of sugars and starch in any grain or other material, the digestibility, and consequently the nutritive value of its non-nitrogenous part, is diminished. We have good reason for believing too, that the net value of that which is digested is less than would be the case if the proportion of starch and sugar had not been reduced.

While the digestion products of fiber and gums are undoubtedly oxidized quite fully and perhaps furnish to the animal their full calorimetric value (except a small proportion of expiratory methan supposed to come from the fiber) the elaborate researches of Zuntz leave little doubt that their net value is less than digested sugars and starch. This is because the work of mastication and digestion of the former is greater.

As a matter of illustration we may refer to the great superiority of corn meal over timothy hay in point of digestibility, the explanation of which is in accordance with the facts just stated. The nitrogen-free extract of maize is mostly starch, the accompanying fiber being insignificant in amount whereas in timothy hay there is found a small proportion of sugars and starch, while gums, fiber and other less digestible compounds are abundant.

Moreover, because of the more resistant qualities of the hay to mastication and propulsion along the alimentary canal, it costs more to digest it than is the case with maize and other grains. Practice recognizes these facts in its estimate of the grains as against the fodders.

The point of this discussion will be seen when we come to consider the figures in the following table.

CARBOHYDRATE RELATIONS IN DRY MATTER OF SEVERAL FEEDING STUFFS.

	Sugars and starch.	Total nitrogen-free extract.	Sugars and starch in nitrogen-free extract.	Digestibility of the nitrogen-free extract.
The Oil Meals:	Per ct.	Per ct.	Per ct.	Per ct.
Cotton-seed meal	16	27.9	57.4	50
Linseed meal, O. P.	13.2	39.2	33.7	78
Linseed meal, N. P.	20.8	40.8	51	84
The Gluten Products:				
Gluten meal	38.2	49.8	76.7	93
Buffalo gluten feed	27.3	58.3	46.8	84
Davenport gluten feed	29.8	60.9	48.9	..
Diamond gluten feed	31.6	61.6	51.3	..
Joliet gluten feed	34	66	51.5	..
Peoria gluten feed	28.9	59.8	48.3	90
Malt sprouts	23.1	49.6	46.6	69
Buckwheat middlings	27.3	48.3	56.5	..
Wheat bran	23.6	60.5	39	69
Wheat middlings	38.8	64.2	60.4	85
Hominy feeds	50.1	72.7	68.9	..
H. O. dairy feed	34.6	60.4	57.3	..
Oat feed	29.4	61.5	47.8	60
Victor feed	43	70.3	61.2	..
Chop feeds	47.5	73.5	64.6	..
X oat feed	16.1	57.9	27.8	..
Wheat, entire grain, Stone	57.9	77.7	74.6	..
Wheat, entire grain, Wiley	72.5	78.5	92.4	..
Maize, entire grain, Stone	66	78	84.6	93
Oats, entire grain, Wiley	50.9	66.3	76.8	83
Mixture, maize and oats, equal parts..	58.4	72.1	81	..

Many of the materials mentioned above when compared with the grains from which they are derived show a depletion of sugars and starch and a corresponding relative increase in the nitrogen-free extract of the less valuable compounds. This is especially true of the wheat offals, the gluten feeds and the oat feed mixtures. In the case of the one sample of gluten meal examined the starch still constituted a large proportion of the nitrogen-free extract. The chop feeds and other similar combinations contain as a rule quite a proportion of corn, that furnishes nearly all the starch which is found in these mixtures. Such materials as the X Oat Feed and

oat chop No. 542 have in them but little starch, these being nearly pure oat offals.

These facts are in harmony with the outcome of digestion experiments, from which we learn that the nitrogen-free extract of the whole grains is much more digestible than that of most of the manufacturing wastes which come from them, as can be seen by the figures in the right hand column of the above table.

Some "mixed feeds" apparently are compounded and advertised on the assumption that feeding stuffs are to be compared in value solely on the basis of their percentage of protein and fat. This is a false basis. The quality of the accompanying carbohydrates must always be considered. For instance it would not be difficult to simulate the composition of corn meal or of wheat middlings by mixing oat hulls with some of the old style linseed meal, adding a little crushed linseed to make up the deficiency of fat. But would the mixture equal corn meal in value? By no means. In one case the protein and fat would be associated with woody fiber in large proportion, and in the other case with little else than starch. The net value of the corn meal would be much above that of the mixture as measured by the extent and labor of digestion.

It is quite clear to the writer that those teachers who publish tables or estimates of feeding stuff comparative values based wholly upon the protein content are misleading the agricultural public and furnishing to manufacturers a justification for false claims.

The relation of oat offals to one class of feeding stuffs has been discussed somewhat at length, because it is proper for farmers to understand its significance. They have a right to know the nature and value of what they are buying, a statement to which no legitimate trade interest will take exception.

MISCELLANEOUS FEEDING STUFFS.

The succeeding table gives the analyses of a number of materials of some interest.

MISCELLANEOUS FEEDING STUFFS.

Station number.	Sample: Where collected.	Ton selling price.	Station number.	Sample; Where collected.	Ton selling price.
558..	Fayetteville	......	512..	Watertown	$18 00
488..	Syracuse	$12 00	520..	Norwich	24 00
505..	Oswego	12 00	560..	Owego	10 20
532..	Binghamton	15 00	506..	Oswego	.10 bu.
541..	Rochester	12 50	547..	Fair Haven	4 00
651..	Sidney	18 00	725..	Gouverneur	......
691..	Central Bridge	17 00	726..	Jordon	......

ANALYSES OF MISCELLANEOUS FEEDING STUFFS.

Station number.		Water.	Ash.	Protein.	Crude fiber.	Sugar and starch.	Nitrogen-free extract.	Fat.
		Per ct.	Per ct.	Per ct.	Per ct	Per ct.	Per ct.	Per ct
558.	Pea meal	10.71	3.45	22.61	13.56	....	48.51	1.16
488.	Malt skimmings	6.16	3.49	15.50	7.93	44.2	64.10	2.82
505.	Malt skimmings	7.24	3.43	13.19	8.41	44.6	65.01	2.72
	Average	6.70	3.46	14.35	8.17	44.4	64.55	2.77
532.	Rye feed	11.68	4.39	15.00	4.99	28.2	60.38	3.56
541.	Rye feed	12.65	2.69	14.13	2.93	39.5	64.66	2.94
651.	Rye feed	10.28	4.03	15.19	5.62	....	61.00	3.88
691.	Rye feed	12.22	3.76	15.56	4.63	....	60.50	3.33
	Average	11.70	3.72	14.97	4.54	33.8	61.82	3.25
512.	Scorched wheat	10.08	1.79	12.13	2.17	55.4	71.93	1.90
520.	Scorched wheat	10.12	1.80	11.94	2.07	59.1	72.28	1.79
720.	Sugar corn feed	9.96	0.93	11.25	11.91	....	60.83	5.12
506.	Starch feed, wet	65.7	0.23	4.25	2.57	11.6	23.88	3.37
	Starch feed, air dry	3.57	0.67	12.37	7.50	33.8	66.07	9.82
547.	"Gluten" feed, wet	58.2	0.31	4.99	4.13	11.[illegible]	27.62	4.75
	"Gluten" feed, air dry	1.98	0.75	11.94	9.89	26.8	64.08	11.36
725.	Clover meal for poultry.	6.49	6.13	9.63	28.31	....	46.21	3.23
726.	Clover meal for poultry.	8.90	6.23	10.38	28.49	....	43.18	2.82

Several points connected with the above analyses are worthy of attention.

The malt skimmings are seen to be quite unlike other brewer's residues, in having a low protein content.

Rye feed, about which questions are frequently asked, corresponds quite closely in composition to wheat offals.

Attention is called to the low protein content of certain feeds which are refuses from starch manufacture. These are not unlike corn meal in the proportion of their constituents and should not be confounded with gluten meals and feeds.

The composition of clover hay is not modified by grinding. So long as cut clover hay is fed successfully to poultry the advantage of paying from $20 to $30 or more per ton for having it ground is not clear.

CONDIMENTAL FOODS.

There is found very prevalent in our markets a class of substances bearing the term "food" that are noted chiefly for being sold in small packages at remarkable prices, on the strength of claims which are sometimes startling even in this time of daily miracles as set forth in the advertising columns of our newspapers. These proprietary wonders are usually marvelous both in their nutritive and their healing effects, for if one may believe the statements concerning some of them, they are remarkably loaded with nutritive energy and the diseases they will not cure would be highly interesting to the veterinarian as pathological novelties. It is most surprising to find after being told that the effect of these "foods" is to enrich milk, produce bovine obesity with remarkable rapidity and banish disease, that so far no one of them has been examined that is not made up largely of some common grain product mixed with more or less of the commonest of drugs and other substances having little curative value, nearly all of which of any merit whatever may be found on the pantry shelf or in the horse stable of many farms. It is strange, too, that farmers have not long ago discovered for themselves, if it is true, that when bran or some other common feeding stuff is compounded with the equally common charcoal, salt, sulphur, saltpetre, fenugreek, etc., the nutritive power of the food is greatly enhanced and the drug takes on unheard of curative properties. Nevertheless we are asked to believe that such is the case. No

evidence of the accuracy of these unusual properties is furnished, save the usual list of testimonials, the reliability of which may be judged in the light of the fact that some of the most absurd impositions ever perpetrated on the public have been abundantly approved by similar evidence. Years ago, Lawes & Gilbert condemned patent foods at the prices for which they are sold, and important experiments conducted in recent years have not furnished the least justification of their purchase by stockmen. Farmers may accept with perfect confidence this statement, viz.: that there are no nutritive properties, compounds or influences yet discovered which are not possessed by the common feeding stuffs, neither is it possible to increase for well animals the nutritive effect of protein and carbohydrates by associating with them any compounds or drugs whatever.

As to the medicinal value of condimental foods, it may be safely asserted that well animals, properly fed, need no medicine, and sick animals should receive treatment specifically adapted to their ailments. Universal preventives and curealls of diseases are unknown and are believed in only by those who are ignorantly credulous. More than this, many of the constituents of condimental foods have no recognized curative value.

But notwithstanding all that has been said again and again to the farming public concerning condimental foods, they still find a sale. Not less than fifteen brands have been examined at this Station during the past two years, all of which were found in the New York markets. Their analyses from a food standpoint follow.

SAMPLES OF PATENT FOODS COLLECTED IN NEW YORK DURING 1898 AND 1899.

Station number.	Sample: Where collected.	Price per pound.	Station number.	Sample: Where collected.	Price per pound.
445..	Corning	.....	459..	Dansville	$0 13 1-3
446..	Corning	$0 20	460..	Mt. Morris	06 1-4
448..	Hornellsville	05	461..	Mt. Morris	10
450..	Hornellsville	25	462..	Buffalo	50
451..	Hornellsville	07 1-3	485..	....	....
456..	Canisteo	25	502..	....	15
457..	Dansville	18	539..	....	....
458..	Dansville	10 1-2			

ANALYSES OF SAMPLES OF PATENT FOODS.

Station number.		Water.	Ash.	Crude protein.	Crude fiber.	Sugar and starch.	Ether extract.
		Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
445.	Flower city horse and cattle food.	9.27	11.29	14.37	9.70	21.0	5.12
446.	International stock food	8.13	9.92	13.88	5.68	21.9	7.91
448.	Blatchford's calf meal	7.12	5.74	26.13	4.23	22.7	4.56
450.	Nutriotone	6.90	20.17	22.19	4.94	23.5	5.13
451.	Pratts' cattle food	7.25	6.36	14.56	5.78	35.4	7.53
456.	Rochester horse and cattle food.	8.00	8.19	18.44	10.59	21.5	3.61
457.	Anglo-American food for stock..	7.20	13.28	15.50	7.86	25.8	4.85
458.	Climax food	7.24	21.09	9.94	4.14	17.2	22.53*
459.	Colonial stock food	7.28	14.51	9.81	11.99	28.8	2.54
460.	Royal stock food	5.56	44.07	11.25	9.73	13.7	3.52
461.	Baums' horse and stock food....	8.05	10.87	27.81	13.00	9.2	7.75
462.	Chas. Marvin stock food	8.26	5.97	30.94	10.63	18.2	4.28
485.	Triplex stock food	7.10	12.05	15.31	6.31	28.8	5.66
502.	Champion horse and cattle food.	8.99	14.40	10.69	4.74	41.2	4.68
539.	Wilbur's seed meal	7.13	12.16	20.00	8.18	20.9	5.63

In these mixtures were found as the principal constituent some common feeding stuff like bran or other wheat offals, corn offals, linseed meal, and so on. The special ingredients added ostensibly for medicinal effect, were found to include charcoal, fenugreek, gentian, sulphur, salt, saltpeter, sodium sulphate, iron compounds and pepper.

Particular attention is called to the prices at which these "foods" are sold. The range is from $100 to $500 per ton, which is at least from $70 to $470 per ton more than the materials are worth for food purposes. It may be claimed, as some of the manufacturers urge, that these mixtures should be regarded as medicines. Even if this is true the farmer who wishes to administer any of these common substances to his animals can do so at a small fraction of their cost in condimental foods by purchasing them as drugs and then mixing them with the grain ration as he wishes. For the promoters of these mixtures to claim that they have any knowledge of compounds and compounding not common to veterinary medicine is charlatanism in its most offensive form.

Blatchford's calf meal is advertised as a food of great value.

* Mostly sulphur.

Director Woods of the Maine Station gave this product a careful examination and his report concerning it includes the following statements.

"These goods were sent to an expert on food mixtures and adulterations at the Connecticut Experiment Station who reports as follows: 'I have examined Blatchford's calf meal under the microscope and find it contains linseed meal, some product from the wheat kernel, some product from the bean kernel and a little fenugreek. The linseed meal appears to be the chief constituent. The wheat product is bran, middlings or some similar product consisting of starchy matter mixed with more or less of the seed coats. Bean bran was present in considerable amount and more or less of the starchy matter.'

"In a letter just at hand from Mr. J. Barwell, the proprietor of these goods, he says: 'Regarding the ingredients, I cannot give you the exact constituents of it, but I may say that it is composed mostly of locust bean meal with leguminous seeds such as lentils, etc., and oleaginous seeds such as flax-seed, fenugreek and anise seed, all cleaned, hulled and ground together and thoroughly well cooked. There is no cheap mill food and no low grade feed enters into this composition. I am prepared to go into any court in the United States and make an affidavit that there is no farmer in the United States that can compound Blatchford's calf meal for less than $3.50 per hundred.'

"Locust bean meal which Mr. Barwell claims to be the chief constituent of Blatchford's calf meal is practically not used in this country as a cattle feed. The average of ten English and German analyses show it to carry: Water, 14.96 per ct.; ash, 2.53 per ct.; protein, 5.86 per ct.; crude fiber, 6.39 per ct.; nitrogen-free-extract, 68.98 per ct.; fat, 1.28 per ct.

"It is evident from the chemical analyses that locust bean meal can not be the chief constituent of Blatchford's calf meal, but that the microscopist is correct that linseed meal is the chief constituent. Locust bean meal has only six per cent of protein and in order to make a mixture carrying from twenty-six to thirty-three per ct.

of protein it would be necessary to add large quantities of goods like linseed meal rich in protein. As seen from the analyses Blatchford's calf meal has a feeding value somewhat inferior to old process linseed meal. Whatever it may cost to manufacture, no man who has sufficient intelligence to mix feeds can afford to buy it at anything like the price asked."

In the light of this information the farmers of New York must decide whether they can afford to pay at the rate of $100 per ton for materials no more valuable than those which are generally offered in our markets at ordinary prices. Special mention is made of this feed because it is sold for distinctively food purposes and because, prices considered, it perhaps does the farmer's pocket-book as little harm as any other food mentioned in the above list, and less than all excepting No. 462. At the same time it typifies all those efforts here discussed of mixing common materials and selling them under extraordinary names at extraordinary prices.

CONCENTRATED FEEDING STUFFS LAW.

Laws of New York, Chap. 510.

AN ACT to amend the agricultural law, regulating the sale and analysis of concentrated feeding stuffs.

Became a law May 3, 1899, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Chapter three hundred and thirty-eight of the laws of eighteen hundred and ninety-three, entitled, "An act in relation to agriculture, constituting articles one, two, three, four and five of chapter thirty-three of the general laws," is hereby amended by adding at the end thereof a new article to be known as article nine, and to read as follows:

ARTICLE IX.

SALE AND ANALYSIS OF CONCENTRATED COMMERCIAL FEEDING STUFFS.

§ 120. Term "concentrated commercial feeding stuff" defined. — The term "concentrated commercial feeding stuffs" as used in this article shall include linseed meals, cottonseed meals, pea-meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewer's grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, ground beef or fish scraps, mixed feeds, and all other material of similar nature; but shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat, and broom corn. Neither shall it include wheat, rye and buckwheat brans or middlings, not mixed with other substances, but sold separately, as distinct articles of commerce, nor pure grains ground together.

§ 121. Statements to be attached to packages; contents; analysis. — Every manufacturer, company or person who shall sell, offer or expose for sale or for distribution in this state any concentrated

commercial feeding stuff, used for feeding farm live stock, shall furnish with each car or other amount shipped in bulk and shall affix to every package of such feeding stuff in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in the package sold or offered for sale, the name or trade mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business and a chemical analysis stating the percentages it contains of crude protein, allowing one per centum of nitrogen to equal six and one-fourth per centum of protein, and of crude fat, both constitutents to be determined by the methods prescribed by the director of the New York Agricultural Experiment Station. Whenever any feeding stuff is sold at retail in bulk or in packages belonging to the purchaser, the agent or dealer, upon request of the purchaser, shall furnish to him the certified statement named in this section.

§ 122. Statements to be filed with director of agricultural experiment station; to be accompanied by sample.— Before any manufacturer, company or person shall sell, offer or expose for sale in this state any concentrated commercial feeding stuffs, he or they shall for each and every feeding stuff bearing a distinguishing name or trade mark, file annually during the month of December with the director of the New York Agricultural Experiment Station a certified copy of the statement specified in the preceding section, said certified copy to be accompanied, when the director shall so request, by a sealed glass jar or bottle containing at least one pound of the feeding stuff to be sold or offered for sale, and the company or person furnishing said sample shall thereupon make affidavit that said sample corresponds within reasonable limits to the feeding stuff which it represents, in the percentage of protein and fat which it contains.

§ 123. License fee.— Each manufacturer, importer, agent or seller of any concentrated commercial feeding stuffs, shall pay annually during the month of December to the treasurer of the New York Agricultural Experiment Station a license fee of twenty-

five dollars. Whenever a manufacturer, importer, agent or seller of concentrated commercial feeding stuffs desires at any time to sell such material and has not paid the license fee therefor in the preceding month of December, as required by this section, he shall pay the license fee prescribed herein before making any such sale. The amount of license fees received by such treasurer pursuant to the provisions of this section shall be paid by him to the treasurer of the state of New York. The treasurer of the state of New York shall pay from such amount when duly appropriated the moneys required for the expense incurred in making such inspection required by this section and enforcing the provisions thereof. The board of control of the New York Agricultural Experiment Station shall report annually to the legislature the amount received pursuant to this article, and the expense incurred for salaries, laboratory expenses, chemical supplies, traveling expenses, printing and other necessary matters. Whenever the manufacturer, importer or shipper of concentrated commercial feeding stuffs shall have filed the statement required by section one hundred and twenty-one of this article and paid the license fee as prescribed in this section, no agent or seller of such manufacturer, importer or shipper shall be required to file such statement or pay such fee.

§ 124. Analysis to be made by director of experiment station; samples to be taken for analysis.— The director of the New York Experiment Station shall annually analyze, or cause to be analyzed, at least one sample to be taken in the manner hereinafter prescribed, of every concentrated commercial feeding stuff sold or offered for sale under the provisions of this act. Said director shall cause a sample to be taken, not exceeding two pounds in weight, for said analysis, from any lot or package of such commercial feeding stuff which may be in the possession of any manufacturer, importer, agent or dealer in this state; but said samples shall be drawn in the presence of the parties in interest, or their representatives and taken from a parcel or a number of packages, which shall not be less than ten per centum of the whole lot sampled, and shall be thoroughly mixed, and then divided into equal samples,

and placed in glass vessels, and carefully sealed and a label placed on each, stating the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the person taking the sample, and by the party or parties in interest or their representative at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the director and the other by the party whose stock was sampled; and the sample or samples retained by the director shall be for comparison with the certified statement named in section one hundred and twenty-two of this article. The result of the analysis of the sample or samples so procured, together with such additional information as circumstances advise, shall be published in reports or bulletins from time to time.

§ 125. Penalty for violation of article.— Any manufacturer, importer, or person who shall sell, offer or expose for sale or for distribution in this State any concentrated commercial feeding stuff, without complying with the requirements of this article, or any feeding stuff which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined not more than one hundred dollars for the first offense, and not more than two hundred dollars for each subsequent offense.

§ 126. Adulterated meal or ground grain; penalty.— Any person who shall adulterate any kind of meal or ground grain with milling or manufacturing offals, or other substance whatever, for the purpose of sale, unless the true composition, mixture or adulteration thereof is plainly marked or indicated upon the package containing the same or in which it is offered for sale; or any person who knowingly sells, or offers for sale any meal or ground grain which has been so adulterated unless the true composition, mixture or adulteration is plainly marked or indicated upon the package containing the same, or in which it is offered for sale, shall be fined not less than twenty-five or more than one hundred dollars for each offense.

§ 127. Violation to be reported to the commissioner of agriculture. —Whenever the director becomes cognizant of the violation of any of the provisions of this article, he shall report such violation to the commissioner of agriculture, and said commissioner of agriculture shall prosecute the party or parties thus reported; but it shall be the duty of said commissioner upon thus ascertaining any violation of this article, to forthwith notify the manufacturer, importer or dealer in writing and give him not less than thirty days thereafter in which to comply with the requirements of this article, but there shall be no prosecution in relation to the quality of any concentrated commercial feeding stuff if the same shall be found substantially equivalent to the certified statement named in section one hundred and twenty-two of this article.

§ 2. This act shall take effect December first, eighteen hundred and ninety-nine.

ANIMAL FOOD FOR POULTRY.*

W. P. WHEELER.

SUMMARY.

Of two rations which contained practically the same proportions of the ordinarily considered groups of constituents, but different amounts of mineral matter, one wholly of vegetable origin proved much inferior for growing chicks to the other ration, higher in ash content, containing animal food.

When the deficiency of mineral matter was made good by the addition of bone ash, the vegetable food ration for chicks equalled or somewhat surpassed in efficiency the corresponding ration in which three-eighths of the protein was derived from animal food.

For laying hens the rations containing animal food proved superior to others in which all the organic matter was derived from vegetable sources. The vegetable-food ration supplemented by bone ash proved equally efficient for limited periods.

Rations containing animal food proved very much superior for ducklings to rations of vegetable origin which had, according to the ordinary methods of estimation, practically the same nutritive value. A ration of vegetable food supplemented by bone ash proved much inferior to another ration of similar "composition" in which three-eighths of the protein came from animal food.

INTRODUCTION.

Information about foods is one of the first essentials in poultry keeping. A very important part of this information concerns the necessity or economy of using animal food. The need for data

* Reprint of Bulletin No. 171.

upon this subject has led to a number of feeding experiments at this station.

Aside from the usual increase in cost of food no results have discredited the moderate use of animal food from healthful sources. In general, rations entirely of vegetable origin have proved much less efficient than corresponding rations which contained animal foods. But it appears that the inferiority is due in some instances more to the lack of sufficient mineral matter than to the less efficient forms of the other food constituents.

The data from some of the preliminary feeding trials were published in Bulletin 149. The rations then fed contained equal amounts of protein; but in part of the ration from two-fifths to one-half of the protein was from animal food, while in contrasted rations it was derived mostly from vegetable sources, although some came from milk curd. Subsequent experiments have corroborated the results then obtained and added to their significance by furnishing supplementary and more extended information. In one series rations in which about 19 per ct. of the dry matter and 37 per ct. of the protein came from animal food proved superior to rations containing an equal amount of protein derived entirely from vegetable food. The rations were similar in nutritive ratio but the one in which animal food was used contained more than twice as much mineral matter and somewhat more fat. In another series the deficiency of mineral matter in the one ration was made good by the addition of bone ash, so that the proportions of protein, ash and fat were alike in the contrasted rations. With this addition a ration of vegetable food was as efficient during certain periods for chicks and hens as a ration containing animal food. For ducklings the vegetable-food ration was thus improved but still did not approach in efficiency the animal food ration.

FIRST SERIES OF EXPERIMENTS.

In this series of experiments ten lots of chicks were fed for ten or twelve weeks and four combined lots afterward for either four

or ten weeks, two lots of laying hens were fed for six and one- half months and two lots for seven and one-half months, and two lots of ducklings for ten weeks. Experimental feeding commenced with the chicks and ducklings when they were one week old and continued until they were ten and twelve weeks old. They were all hatched in incubators and reared in brooders. A small out-door run on bare ground was allowed each lot. Occasionally a chick escaped through the fence into outside flocks where it could not be identified and was dropped from the lot. In a few lots (Lot VII especially) there was considerable loss at one time from sunstroke caused by accidental exposure. Allowance was made for any loss caused by accident, obviously uninfluenced by feeding. The weight of any that died was accounted in the record as loss in live weight when estimating the food cost per pound gain.

RATIONS.

One ration for chicks and hens consisted of wheat, cracked corn, barley, oats and a mixture (No. 1) composed of 14 parts by weight corn meal, 11 parts animal meal, 2 parts each of ground oats, wheat bran and pea meal, and one part each of wheat middlings, O. P. linseed meal, malt sprouts, brewer's grains and gluten meal. The contrasted ration consisted of wheat, barley, oats and a grain mixture (No. 2) composed of 7 parts each of pea meal and wheat bran, 6 parts of O. P. linseed meal, 4 parts of gluten meal, 3 parts each of corn meal and ground oats and 2 parts each of malt sprouts, brewer's grains and wheat middlings. One pound of salt was added to every 360 pounds of each mixture. Each ration for ducklings contained, with one of these mixtures, wheat bran, corn meal and ground oats.

The animal food used in these experiments was the dried and ground animal meal. Dried blood, fresh bone, beef scraps and pork scraps have often been fed at this Station, but owing to the

inferior palatability of some grades of dried blood and the poor keeping qualities or continual variations in composition of different lots of the other foods, they were not so suitable for use in these experiments.

Green alfalfa was fed to all lots. Oyster shells and grit were fed to the hens and sand and coarse grit to the chicks and ducklings.

VALUATION OF FOODS.

In estimating the cost of the foods the same valuations have been assumed, for convenience of comparison, that had been used in the preliminary series of experiments, although they are most of them lower than the present market prices and those that existed during part of the last series of experiments. Wheat bran, wheat middlings, corn meal, malt sprouts and brewer's grains were rated at $13 per ton, pea meal at $13.50, buckwheat middlings at $14.40, ground oats at $16, linseed meal at $20, gluten meal at $23, ground flaxseed, bone ash and animal meal at $40 per ton. Corn was rated at 40 cents per bushel, barley at 39 cents, oats at 26 cents, and wheat at 80 cents. Alfalfa hay was rated at $10 and green alfalfa at $2 per ton.

In these experiments the cost of the ration could only be a secondary consideration; but only ordinary foods were used and the relations between valuations is a natural one, similar to what would generally exist between rations of vegetable and mixed origin. The data in regard to the food cost of growth are therefore important.

The food used in the first series of experiments had the average composition[1] shown in the accompanying table.

[1] Most of the analyses of foods used in these experiments were made by Mr. J. A. Le Clerc. Some ash analyses were made by Mr. W. H. Andrews. Very much of the credit is due to Mr. P. F. O'Neill; for the successful control of the experiments has been dependent on his careful and skillful management.

TABLE I.— COMPOSITION OF FOODS USED IN FIRST SERIES OF POULTRY FEEDING EXPERIMENTS.

FOOD.	Water.	Ash.	Protein.	Albuminoids.	Fiber.	Nitrogen-free extract.	Fats (ether extract.)
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Mixture 1	11.8	13.6	19.8	17.4	3.7	45.4	5.7
Mixture 2	13.9	3.9	19.9	18.6	6.5	52.9	3.8
Animal meal	7.3	38.7	33.8	26.2	1.7	7.7	10.8
Corn meal	14.8	1.4	8.7	8.7	1.6	70.1	3.4
Wheat bran	14.7	6.3	15.7	14.7	9.1	49.4	4.8
Ground oats	15.9	2.8	12.6	12.4	9.5	54.8	4.4
Corn	15.1	1.4	9.5	9.4	1.4	68.9	3.7
Wheat	15.7	1.8	10.6	9.7	2.3	67.9	1.7
Oats	15.1	3.1	12.2	12.1	10.1	54.9	4.6
Barley	14.1	2.6	10.8	10.4	4.6	65.9	2.0
Alfalfa, green	78.1	1.9	4.2	....	5.8	9.1	.9
Alfalfa hay	16.0	9.1	16.8	....	23.2	32.6	2.3

EXPERIMENT WITH CHICKS.

In two lots of this series of experiments the chicks were two weeks old when the experiment began, in all the others one week old. Lots I, III, V, VII and IX were fed the ration containing animal meal and Lots II, IV, VI, VIII and X were fed the contrasted ration. At the start Lot I was similar in every way to Lot II. The same was true of Lots III and IV, V and VI, VII, and VIII, and IX and X. After the first four lots had been fed for eight weeks the cockerels were removed and a number of pullets from Lots I and III were fed for ten weeks in comparison with an equal number from Lots II and IV. Later, chicks from Lots V and VII after removal of many of the cockerels were fed together in comparison with others from Lots VI and VIII.

The chicks in Lots I and II were Leghorns, those in III and IV mostly Leghorns with a few Wyandottes. Half of those in Lots V, VI, VII and VIII were Leghorns and half Wyandottes and crosses. In Lots IX and X somewhat more than half the chicks were Wyandottes and crosses and the remainder Leghorns.

The records of feeding and statements of the results follow in tabulated form, the averages in most cases being for 14-day periods.

TABLE II.—CHICKS FED ANIMAL FOOD. LOT I.

Forty per cent. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 1.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	2	.3	41	5.1	1.2	1.2	.5	.5	.7	1.4	.8	.4	1:4.2	.6	.5	.04	3.2	2.7	2.7	2.3
14	4	.5	41	8.1	2.3	2.0	1.0	1.0	1.7	2.3	1.3	.7	1:4.4	1.2	.9	.07	3.1	2.3	4.7	4.1
14	6	.9	41	12.8	2.6	2.5	1.3	1.2	2.4	3.4	1.9	1.0	1:4.1	1.6	1.3	.09	5.9	1.9	3.6	3.1
14	8	1.2	41	17.1	3.3	3.1	1.5	1.9	3.1	4.6	2.6	1.3	1:4.1	2.1	1.7	.12	5.3	1.6	5.3	4.6

TABLE III.—CHICKS FED VEGETABLE FOOD. LOT II.

A Ration of Vegetable Food Only.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period.													Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
				Mixture 2.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.				
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	2	.3	42	4.4	...	1.4	.9	.4	.7	1.2	.2	.2	1:4.3	.6	.5	.03	2.0	2.3	3.2	3.1
14	4	.5	41	8.3	...	3.0	1.9	1.0	1.7	2.4	.5	.5	1:4.4	1.1	.9	.06	3.5	2.2	3.7	3.5
14	6	.8	41	12.1	...	3.6	2.5	1.2	2.4	3.3	.7	.6	1:4.3	1.6	1.2	.08	4.7	1.9	3.7	3.7
14	8	1.0	41	13.4	...	4.3	2.9	1.5	3.1	3.7	.8	.7	1:4.3	1.8	1.4	.09	2.5	1.6	7.8	7.7

TABLE IV.—CHICKS FED ANIMAL FOOD. LOT III.

Thirty-eight per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 1.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	1	.3	23	6.3	1.2	1.8	.5	.6	.6	1.6	.9	.5	1:4.1	.7	.6	.05	2.8	1.6	3.7	3.0
14	3	.6	22	11.0	2.5	2.4	1.1	1.3	1.7	3.0	1.7	.9	1:4.2	1.4	1.2	.08	5.3	2.6	3.6	2.9
14	5	.9	22	16.1	3.7	3.8	2.1	1.9	2.3	4.5	2.5	1.3	1:4.3	2.1	1.7	.13	4.1	2.3	6.9	6.0
14	7	1.2	22	20.6	4.4	4.4	2.2	2.2	3.5	5.6	3.1	1.6	1:4.2	2.7	2.1	.15	5.9	2.1	5.9	5.1
*14	10.5	1.8	33	23.4	5.7	5.7	2.6	2.8	8.5	6.8	3.7	1.9	1:4.3	3.5	2.6	.18	7.1	1.6	5.8	5.2
*28	12.5	2.4	33	42.4	8.7	9.2	3.9	4.6	17.0	11.9	6.6	3.3	1:4.2	3.1	2.3	.16	9.2	1.1	7.9	6.4
*28	16.5	3.3	32	67.1	14.8	14.8	7.4	7.4	17.5	18.7	10.4	5.3	1:4.2	4.6	3.6	.26	13.1	1.3	8.9	7.7

* Pullets from Lots I and III, after removal of cockerels.

TABLE V.—CHICKS FED VEGETABLE FOOD. LOT IV.

A Ration of Vegetable Food Only.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 2.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day	Cost of food per day.	Average gain in weight per chick during period	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	1	.3	23	4.8	...	1.7	1.3	.6	.6	1.4	.3	.3	1:4.4	.6	.5	.03	2.8	2.6	2.7	2.6
14	3	.6	23	8.4	...	3.3	2.0	1.1	1.5	2.4	.5	.5	1:4.2	1.2	.9	.06	4.8	2.1	2.8	2.7
14	5	.9	23	15.3	...	4.1	2.6	1.3	2.1	4.0	.8	.8	1:4.5	1.8	1.5	.09	4.7	2.0	4.4	4.4
14	7	1.1	23	14.1	...	5.9	3.8	2.0	3.4	4.2	.9	.8	1:4.4	2.1	1.6	.11	2.4	1.6	9.9	9.7
*14	10.5	1.3	33	17.7	...	6.6	4.0	2.4	8.5	5.3	1.1	1.1	1:4.4	2.8	2.0	.13	2.8	1.7	10.1	9.0
*28	12.5	1.7	33	33.8	...	10.2	7.0	3.3	17.0	9.7	2.1	1.9	1:4.3	2.5	1.8	.11	6.5	1.2	7.6	7.8
*28	16.5	2.3	33	52.2	...	18.6	11.9	6.2	17.0	15.1	3.2	3.0	1:4.4	3.8	2.9	.18	9.9	1.4	8.2	8.1

* Pullets from Lots II and IV, after removal of cockerels.

TABLE VI.— CHICKS FED ANIMAL FOOD. LOT V.

Thirty-seven per ct. of the Protein in the Ration from Animal Food.

				Average per fowl for period.																
Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Mixture 1.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	1	.3	44	4.6	.8	.9	.5	.5	.9	1.2	.7	.3	1:4.1	.6	.5	.03	2.3	2.3	3.5	2.9
14	3	.4	41	7.4	1.6	1.8	.9	.9	1.6	2.1	1.1	.6	1:4.2	1.0	.8	.06	2.8	2.3	6.4	4.0
14	5	.7	38	10.9	2.3	2.7	1.0	1.2	2.8	3.0	1.7	.9	1:4.2	1.5	1.2	.08	4.3	2.1	4.4	3.8
14	7	1.0	35	15.0	3.2	3.1	1.9	1.6	5.2	4.2	2.3	1.2	1:4.2	2.1	1.6	.11	4.1	1.9	7.1	5.6
21	9	1.6	35	28.9	6.1	6.9	3.7	3.7	9.6	8.3	4.5	2.3	1:4.2	2.8	2.1	.15	10.0	1.7	5.1	4.5

TABLE VII.— CHICKS FED VEGETABLE FOOD. LOT VI.

A Ration of Vegetable Food Only.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 2.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	1	.3	43	4.1	...	1.3	.8	.4	1.0	1.1	.2	.2	1:4.3	.5	.4	.03	2.3	2.1	2.7	2.6
14	3	.4	42	7.6	...	2.4	1.6	.7	1.6	2.1	.4	.4	1:4.3	1.0	.8	.05	2.3	2.3	5.6	4.9
14	5	.5	40	8.6	...	2.9	1.9	1.1	2.7	2.5	.5	.5	1:4.4	1.2	.9	.06	1.4	2.1	9.9	9.0
14	7	.8	40	10.5	...	3.5	2.4	1.3	4.6	3.1	.7	.6	1:4.3	1.6	1.2	.07	4.9	1.8	3.3	3.3
21	9	1.1	40	21.9	...	8.0	5.4	2.8	8.4	6.5	1.4	1.3	1:4.4	2.2	1.7	.11	5.2	1.7	7.0	6.7

TABLE VIII.—CHICKS FED ANIMAL FOOD. LOT VII.

Thirty-six per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 1.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	1	.3	44	4.7	.9	.9	.5	.5	1.3	1.3	.7	.4	1:4.1	.6	.5	.03	2.3	2.5	3.6	3.0
14	3	.5	41	7.2	1.7	1.7	.9	.8	2.0	2.1	1.1	.6	1:4.3	1.0	.8	.06	2.7	2.0	3.6	4.2
14	5	.7	39	11.0	2.9	2.4	1.1	1.3	2.9	3.1	1.7	.9	1:4.2	1.5	1.2	.08	3.8	2.0	5.1	4.5
14	7	.9	31	14.1	2.5	3.2	1.7	1.4	5.3	4.0	2.2	1.1	1:4.2	2.0	1.5	.11	3.9	1.9	6.5	5.4
21	9	1.5	29	24.8	5.7	5.7	2.8	3.0	8.7	7.1	3.9	2.0	1:4.2	2.4	1.8	.13	8.9	1.5	4.9	4.3
*28	12	2.7	47	37.9	10.3	9.4	4.6	4.6	11.2	11.0	5.9	3.1	1:4.3	2.8	2.2	.15	17.3	1.0	3.9	3.5
†28	..	3.1	56	54.8	12.0	12.1	6.0	6.0	10.0	15.1	8.4	4.3	1:4.2	3.6	2.9	.21	5.8	1.0	16.0	13.9

* Combined Lots V and VII, after removal of the largest cockerels.

† Pullets from Lots I, III, V, and VII.

TABLE IX.—CHICKS FED VEGETABLE FOOD. LOT VIII.

A Ration of Vegetable Food Only.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 2.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound ga'n in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Oz	Cts	Lbs.
14	1	.3	44	4.0	1.4	.9	.4	1.3	1.1	.2	.2	1:4.3	.6	.4	.03	2.4	2.2	2.6	2.5
14	3	.4	44	6.5	2.1	1.2	.6	1.9	1.8	.4	.3	1:4.3	.9	.7	.04	2.6	1.9	3.7	3.6
14	5	.7	42	8.0	2.7	2.0	.9	2.7	2.3	.5	.5	1:4.4	1.2	.9	.05	3.1	1.6	4.1	4.0
14	7	.8	39	11.0	3.7	2.4	1.2	4.3	3.2	.7	.6	1:4.3	1.6	1.2	.07	2.7	1.6	7.7	6.2
21	9	1.1	37	20.1	7.6	4.6	2.5	6.9	5.9	1.2	1.2	1:4.4	2.0	1.5	.09	4.1	1.6	8.3	7.7
*28	12	1.7	53	33.3	9.5	6.6	3.3	9.9	9.2	1.9	1.8	1:4.2	2.2	1.7	.11	11.2	1.3	4.3	4.3
†28	..	2.9	64	38.9	12.7	8.1	4.2	8.8	10.8	2.3	2.1	1:4.3	2.6	2.0	.13	11.4	.8	5.0	5.0

* Combined Lots VI and VIII, after removal of the largest cockerels.
† Pullets from Lots II, IV, VI, and VIII.

TABLE X.—CHICKS FED ANIMAL FOOD. LOT IX.

Thirty-seven per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Av. rage age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 1.	Corn.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	1	.3	51	4.5	.9	.8	.4	.4	1.1	1.2	.7	.3	1:4.1	.6	.5	.03	1.8	2.3	4.3	3.5
14	3	.4	46	5.7	1.5	1.6	.8	.8	1.8	1.7	.9	.5	1:4.4	.9	.7	.05	2.3	1.9	4.6	3.6
14	5	.7	44	9.2	1.8	1.8	.9	.9	2.6	2.5	1.4	.7	1:4.1	1.2	.9	.07	3.7	1.7	4.1	3.6
14	7	.9	43	11.4	3.0	2.8	1.6	1.6	3.9	3.4	1.8	.9	1:4.3	1.7	1.3	.09	3.5	1.7	7.5	5.4
21	9	1.4	40	24.3	5.3	5.1	2.6	2.6	7.4	6.8	3.8	1.9	1:4.2	2.3	1.7	.12	7.2	1.5	6.2	5.0
*28	12	2.1	24	49.8	10.3	10.7	5.0	5.1	11.7	13.6	7.6	3.8	1:4.2	3.3	2.6	.18	14.3	1.6	5.8	5.1
*28	..	3.1	24	61.5	13.3	14.0	6.6	6.7	11.7	16.9	9.4	4.8	1:4.2	4.1	3.3	.23	16.1	1.3	6.5	5.6

* Pullets only, after removal of the cockerels.

TABLE XI.—CHICKS FED VEGETABLE FOOD. LOT X.

A Ration of Vegetable Food Only.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 2.	Wheat.	Barley.	Oats.	Green alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
14	1	.2	50	4.6	1.3	.8	.5	1.1	1.3	.3	.2	1:4.2	.6	.5	.03	1.1	3.1	6.5	5.8
14	3	.3	46	5.0	2.2	1.5	.7	1.8	1.5	.3	.3	1:4.5	.8	.6	.04	1.0	2.4	11.3	8.7
14	5	.4	41	7.1	2.0	1.6	.7	2.7	2.0	.4	.4	1:4.3	1.0	.7	.05	2.3	2.1	4.5	4.5
14	7	.5	40	8.4	3.2	2.0	1.0	4.2	2.5	.5	.5	1:4.4	1.3	1.0	.06	1.8	2.1	9.1	7.7
21	9	.8	36	16.0	3.6	3.5	2.0	8.2	4.5	1.0	.9	1:4.2	1.6	1.1	.07	2.9	1.7	10.6	8.0
*28	12	1.4	18	51.0	15.8	11.0	5.0	15.6	14.3	3.0	2.8	1:4.3	3.5	2.7	.16	11.5	2.5	6.5	6.5
*28	..	2.4	18	43.7	21.7	15.8	8.2	15.6	14.3	3.1	2.9	1:4.6	3.7	2.9	.18	15.4	1.5	5.4	5.2

* Pullets only, after removal of the cockerels.

RELATIVE EFFICIENCY OF THE RATIONS FOR CHICKS.

More food was eaten by the chicks having the ration containing animal meal. Calculated on the basis of dry matter the food consumption for Lot I was 12 per ct. greater than for Lot II and the gain in weight 37 per ct. greater. Lot I gained one pound for every 3.6 pounds of dry matter in the food and Lot II gained one pound for every 4.3 pounds of dry matter.

Lot III consumed 24 per ct. more food than Lot IV and made 22 per ct. greater gain in weight. The dry matter in the food consumed for each pound gain in weight was about 4.3 pounds for Lot III and 4.4 pounds for Lot IV.

During the following ten weeks when pullets from Lots I and III were fed in comparison with those from Lots II and IV the consumption of food under the animal meal ration was 26 per ct. greater and the gain made was 53 per ct. greater. The dry matter in the food for each pound gain was 6.6 pounds for Lots I and III and 8.1 pounds for Lots II and IV.

The food consumption of Lot V was 26 per ct. greater than that of Lot VI and the gain in weight 45 per ct. greater. The dry matter in the food for each pound gain in weight was 4.3 pounds for Lot V and 5.0 pounds for Lot VI.

The food consumption of Lot VII was 24 per ct. greater than that of Lot VIII and the gain in weight was 45 per ct. greater. The dry matter in the food for each pound gain in weight was 4.3 pounds for Lot VII and 5.0 pounds for Lot VIII.

During the four weeks that pullets from Lots V and VII were fed in comparison with those from Lots VI and VIII, 37 per ct. more food was consumed under the animal food ration than under the other, and the gain in weight was 54 per ct. greater. The dry matter in the food for each pound gain in weight was 3.5 pounds for the former lots and 4.3 pounds for the latter.

The food consumption of Lot IX was 34 per ct. greater than that of Lot X and the gain in weight more than twice as great. The dry matter in the food for each pound gain in weight was

4.4 pounds for Lot IX and 6.8 pounds for Lot X. During four weeks after the cockerels were removed Lot X consumed about 5 per ct. more food than Lot IX but the latter made 24 per ct. greater gain in weight. The dry matter in the food for each pound gain in weight was 5.1 pounds for Lot IX and 6.5 pounds for Lot X. During the following four weeks about 14 per ct. more food was eaten by Lot IX and only about 4 per ct. greater gain made. The dry matter in the food for each pound gain was about 5.6 pounds for Lot IX and 5.2 pounds for Lot X.

RELATIVE ECONOMY OF THE RATIONS FOR CHICKS.

The cost of food per pound gain in weight for Lot I was 4.1 cents and for Lot II 4.4 cents. For Lot III it was 5.1 cents and for Lot IV 4.5 cents. For the ten weeks with the pullets of the combined lots the cost was 7.7 cents for Lots I and III and 8.3 cents for Lots II and IV.

The food cost of the growth made during the first eleven weeks by Lot V was 4.9 cents and of that made by Lot VI was 5.0 cents. The cost of that made during this time by Lot VII was 5.1 cents and of that made by Lot VIII 5.4 cents. When the pullets from the combined lots were fed for four weeks longer the cost of the gain made by the birds from Lots V and VII was 3.9 cents and of that made by Lots VI and VIII 4.3 cents. After adding to these lots some more matured pullets from the earlier lots, the one combined lot of older birds, from I, III, V and VII, made for a month a slow and costly gain while the others, from II, IV, VI and VIII, whose growth had been slower, still made good gains at moderate cost. The food cost of the gain made by Lot IX was 5.5 cents and of that made by Lot X 8.0 cents per pound.

Owing to the large proportion of Leghorns among the chicks, heavy average weights were never reached, but average weights of one, two and three pounds were always attained much sooner by the chicks having the animal food ration. The first four lots reached the average weight of one-half pound at about the same

time. Lots V and VII averaged one-half pound in weight over a week sooner than Lots VI and VIII and Lot IX over two weeks sooner than Lot X. The average weight of one pound was reached by Lots I and III about a week sooner than by Lots II and IV, the average weight of 1.5 pounds three and one-half weeks sooner, and the average weight of 2 pounds four and four-fifths weeks sooner. The average weight of one pound was reached by Lots V and VII two weeks sooner than by Lots VI and VIII, the average weight of 1.5 pounds over three weeks sooner, the average weight of 2 pounds three and three-fifths weeks sooner, the average weight of 2.5 pounds over four weeks sooner. The average weight of one pound was reached by Lot IX three weeks sooner than by Lot X, the average weight of 1.5 pounds three and four-fifths weeks sooner and the average weight of 2 pounds three weeks sooner.

EXPERIMENT WITH DUCKLINGS.

In the experiment with ducklings the birds in the two lots were all Pekins. Lot A had the rations mentioned on page 77 containing animal food and Lot B the ration of vegetable food. These rations were fed unchanged during the first month. It was then evident that the one ration was very deficient in some respect, for before the end of the fourth week one-half of all the birds in Lot B had died. Animal meal was then added to the ration, otherwise unchanged, for three weeks and then for two weeks longer the original ration was fed. Only one bird died after the first change in the ration. None died in Lot A. After the ten weeks Lot B was fed for five weeks on the ration which had been fed to Lot A, and Lot A was also fed the same ration for three weeks longer. The tabulated data follow:

TABLE XII.—DUCKLINGS FED ANIMAL FOOD. LOT "A."

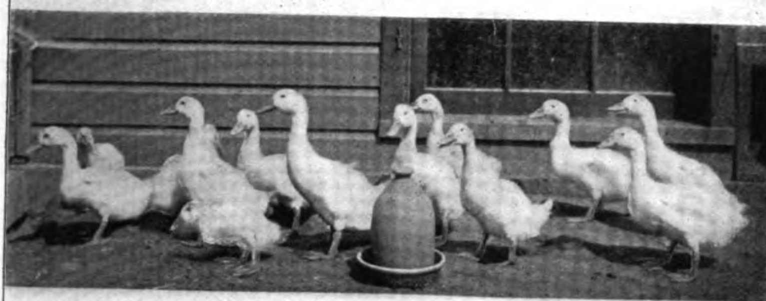
Thirty-seven per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of ducklings at beginning of period.	Average weight of ducklings at end of period.	Number of fowls.	Average per fowl for period. Mixture 1.	Corn meal.	Wheat bran.	Ground oats.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per fowl during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1	.4	26	5.5	1.4	.2	.5	.8	1.3	.8	.4	1:3.9	1.2	1.0	.07	4.1	3.9	1.8	1.7
7	2	.6	26	5.0	2.0	1.7	1.5	1.6	1.7	.9	.5	1:4.3	1.7	1.3	.08	4.1	2.6	2.2	2.2
7	3	1.1	26	15.7	3.8	2.4	2.1	1.6	4.2	2.4	1.2	1:3.9	3.7	3.0	.20	7.3	3.6	3.2	2.9
7	4	1.6	26	13.3	4.7	3.5	3.4	4.3	4.2	2.3	1.3	1:4.2	4.2	3.2	.20	7.6	2.4	3.0	2.9
7	5	2.1	26	21.4	5.8	3.8	4.0	4.3	6.0	3.4	1.8	1:4.0	5.6	4.5	.29	7.9	2.4	4.2	3.9
7	8	3.0	26	17.2	5.8	4.1	3.8	8.6	5.4	2.9	1.6	1:4.2	5.6	4.1	.26	15.0	1.6	1.9	1.9
7	7	3.5	26	20.4	6.1	4.1	4.4	8.6	6.1	3.4	1.8	1:4.1	6.2	4.6	.30	[illegible]6	1.4	3.9	3.8
7	8	4.2	26	32.0	9.3	6.4	6.2	10.8	9.4	5.3	2.8	1:4.1	9.2	7.0	.45	10.3	1.8	4.9	4.8
7	9	4.9	26	33.2	9.9	5.8	6.7	10.8	9.6	5.4	2.9	1:4.1	9.5	7.2	.47	11.5	1.6	4.6	4.4
21	10	5.9	26	78.2	23.8	16.5	15.9	32.3	23.5	13.1	7.0	1:4.1	7.9	5.9	.37	16.7	1.1	7.6	7.4

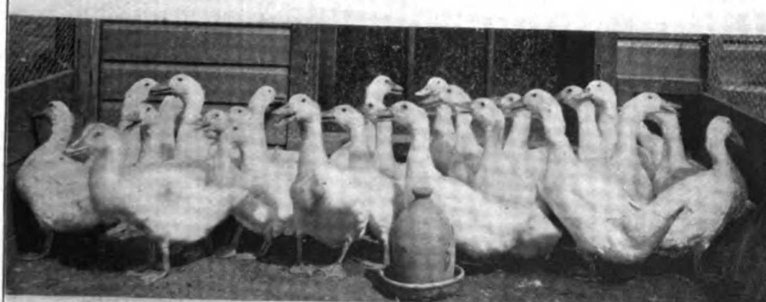
TABLE XIII.—DUCKLINGS FED VEGETABLE FOOD. LOT "B."

A Ration of Vegetable Food Only, for Part of the Time.

Number o days in period.	Average age of ducklings at begin ing of period.	Average we'ght of ducklings at end of period.	Number of fowls.	Average per fowl for period. Mixture 2.	Co n meal.	Wheat bran.	Ground oats.	Animal meal.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per fowl during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1	.2	27	4.5	.4	.2	.7	...	...	5.0	.2	.2	1:3.9	.8	.7	.04	1.7	4.8	2.6	2.7
7	2	.3	25	3.8	.4	2.3	.6	...	1.7	6.5	.3	.3	1:4.0	1.3	.9	.05	.5	3.7	11.9	8.4
7	3	.4	21	4.8	.5	2.5	1.3	...	2.0	8.3	.4	.4	1:4.1	1.6	1.2	.06	...	3.4	....	7.8
7	4	.4	15	5.8	.3	1.9	1.3	...	4.4	8.9	.5	.4	1:4.0	2.0	1.3	.07	...	3.2	....	14.9
7	5	.7	13	11.4	1.3	3.0	1.5	3.5	5.4	19.3	2.1	1.1	1:3.2	3.7	2.8	.18	3.8	5.0	5.3	4.4
7	6	1.1	13	5.6	.5	4.0	1.6	9.0	6.5	19.8	4.1	1.5	1:2.3	3.9	2.8	.24	5.9	3.1	4.6	3.4
7	7	1.7	13	14.1	1.1	3.0	4.3	4.8	6.5	25.2	2.8	1.5	1:3.2	4.8	3.6	.24	9.0	2.6	3.0	2.8
7	8	2.0	13	23.7	2.5	10.2	8.5	...	8.6	36.2	1.9	1.7	1:4.0	6.9	5.2	.27	4.9	2.8	3.4	7.4
7	9	2.3	13	26.2	2.4	6.8	4.9	...	8.6	36.6	1.8	1.7	1:4.0	7.0	5.2	.28	2.3	2.4	13.3	8.1
				Mixture I.																
35	10	5.5	12	166.4	56.4	47.6	39.4	...	53.7	280.3	28.5	15.9	1:4.2	10.4	8.0	.55	51.2	.1	5.6	5.1



DUCKLINGS OF LOT B — NINE WEEKS OLD.
AVERAGE WT. = 2 POUNDS. VEGETABLE FOOD ONLY FOR PART OF THE TIME. HALF OF THE NUMBER DIED BEFORE OTHER FOOD WAS SUPPLIED



DUCKLINGS OF LOT A — NINE WEEKS OLD.
AVERAGE WT. 4.2 POUNDS. THE RATION CONTAINED ANIMAL FOOD. NO LOSS.

PLATE I.

RELATIVE EFFICIENCY OF THE RATIONS FOR DUCKLINGS.

The ration containing the animal meal was more freely eaten. Calculated on the basis of dry matter the food consumed by Lot A during the first four weeks was more than twice as much as that by Lot B and the net gain in weight more than ten times as great. For each pound gain in weight there were 2.6 pounds of dry matter in the food for Lot A and 6 pounds for Lot B.

During the following five weeks 40 per ct. more food was consumed by Lot A than by Lot B and the gain in weight made by Lot A was more than twice that made by Lot B. The amount of dry matter in the food for each pound gain was 3.6 pounds for Lot A and 4.8 pounds for Lot B. For the nine weeks over 50 per ct. more food was consumed by Lot A and the total net gain in weight was 2.7 times more than that of Lot B. There were 3.3 pounds of dry matter in the food for Lot A for each pound gain in weight and 5 pounds for Lot B.

When the birds remaining in Lot B were finally changed to the ration that had been fed to Lot A a rapid growth was made and while the gains were not so good as had been previously made by Lot A they were better than those made at this time by the more nearly mature birds in Lot A during three weeks feeding on the same ration. For the five weeks there were 5.1 pounds of dry matter in the food for Lot B for each pound gain in weight and for the three weeks for Lot A 7.4 pounds for each pound gain in weight. It was therefore apparent that while the vegetable food ration greatly retarded the growth up to ten weeks of age and was the cause of great mortality, it did not prevent a rapid and profitable growth by the surviving birds under the better ration. The effect of the first few weeks under the inferior ration could not be entirely overcome however, and the birds from Lot B never reached as satisfactory development as did the others.

RELATIVE ECONOMY OF THE RATIONS FOR DUCKLINGS.

The cost of the food for each pound gain in weight during the first four weeks of the experiment was for Lot A 2.7 cents and

for Lot B 10.1 cents. During the next five weeks the cost was 3.7 cents for Lot A and 5.3 cents for Lot B. For the whole time up to ten weeks of age the food cost per pound gain was 3.4 cents for Lot A and 5.9 cents for Lot B. After Lot B was finally changed to the animal food ration the food cost per pound gain for the five weeks was 5.6 cents. The food cost per pound gain in weight made at this time by Lot A for three weeks after they had reached the average weight of five pounds was 7.6 cents.

At ten weeks of age the ducklings in Lot A averaged 4.9 pounds in weight and those in Lot B 2 pounds. At seven weeks of age those in Lot A averaged 3 pounds in weight and those in Lot B 1.1 pounds. The ducklings in Lot B at five weeks of age, up to which time they had been restricted to the unmodified vegetable food ration averaged but 0.4 pound in weight while those in Lot A averaged four times as heavy. Even with the addition of other food to the vegetable food ration, followed later by a total change, the ducklings in Lot A reached the average weight of one pound three weeks sooner than those in Lot B. The average weight of 2 pounds was reached more than three weeks sooner, the average weight of 3 pounds four and one-half weeks sooner, the average weight of 4 pounds and the average weight of 5 pounds each a month sooner. The average weight of 5 pounds was attained by Lot A when Lot B averaged but little over 2 pounds in weight.

Besides avoiding the serious loss that occurred under the ration entirely of vegetable food, the chief advantage of the animal food ration was in the much more rapid growth and earlier maturity and not so much in the ultimate attainment of greater size.

FEEDING EXPERIMENT WITH HENS.

Of the four lots of laying hens used in this series of experiments, Lots XVII and XVIII were fed the contrasted rations for about seven and one-half months and Lots XIX and XX for about six and one-half months. This included the principal

part of the laying season. Lots XIX and XX were alike at the start, containing equal numbers of two-year-old Wyandotte hens. Lots XVII and XVIII contained equal numbers of Leghorn pullets. The pullets in Lot XVII had been fed from the day they were hatched a ration which contained a large proportion of animal food, while those in Lot XVIII had been grown on a ration of vegetable food supplemented by some skim milk curd. Some of the pullets in both lots had been laying for some time before this experiment began but those in Lot XVII had commenced laying several weeks younger than those in Lot XVIII. The hens in the other two lots had been treated alike until used in this experiment. Lots XVII and XIX were fed the ration containing animal meal described on page 77 and Lots XVIII and XX were fed the contrasted ration.

The accompanying tables give the data averaged for periods generally of four weeks.

TABLE XIV.— YOUNG HENS FED ANIMAL FOOD. LOT XVII.

Thirty-five per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average weight per fowl during period.	Number of hens.	Average per fowl for period.															Dry matter in food per day for each pound live weight fed.	Cost of food for each pound of eggs produced.	Dry matter in food for each pound of eggs produced.
			Mixture 1.	Corn.	Wheat.	Barley.	Oats.	Alfalfa hay.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Number of eggs.	Weight of eggs.			
	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs	Ozs	Cts.		Ozs.	Ozs.	Cts.	Lbs.
28	3.4	15	67.2	14.9	14.9	7.5	7.5	11.2	19.9	11.1	5.4	1:4.2	4.4	3.8	.27	11.3	21.1	1.1	5.6	5.1
28	3.6	15	62.0	12.5	13.2	6.3	6.3	7.5	17.6	9.9	4.8	1:4.1	3.9	3.3	.24	12.3	23.5	.9	4.5	4.0
28	3.6	10	54.3	14.2	12.9	7.0	7.0	10.7	16.9	9.2	4.5	1:4.2	3.8	3.3	.22	18.2	34.3	.9	3.0	2.7
28	3.5	10	62.9	13.7	14.0	6.9	6.9	10.7	18.6	10.4	5.0	1:4.2	4.1	3.6	.25	17.9	35.3	1.0	3.1	2.8
								Green.												
28	3.4	10	60.2	12.8	13.0	6.5	6.3	42.7	17.8	9.8	4.9	1:4.2	5.1	3.4	.23	19.2	37.6	1.0	2.8	2.5
35	3.1	10	88.9	20.0	19.5	9.9	10.5	53.3	26.2	14.3	7.3	1:4.2	5.8	4.0	.28	17.3	33.9	1.3	4.6	4.2
21	3.0	10	33.9	7.2	7.4	3.6	3.2	33.6	10.4	5.7	2.8	1:4.2	4.2	2.6	.18	6.8	13.0	.9	4.6	4.3
28	3.0	10	61.7	14.2	15.1	7.9	7.6	49.8	19.0	10.2	5.3	1:4.3	5.6	3.7	.25	7.1	13.7	1.3	8.2	7.6

TABLE XV.— YOUNG HENS FED VEGETABLE FOOD. LOT XVIII.

A Ration of Vegetable Food Only.

Number of days in period.	Average weight per fowl during period.	Number of hens.	Average per fowl for period. Mixture 2.	Wheat.	Corn.	Barley.	Oats.	Alfalfa hay.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Number of eggs.	Weight of eggs.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound of eggs produced.	Dry matter in food for each pound of eggs produced.
	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.		Ozs.	Ozs.	Cts.	Lbs.
28	3.2	15	41.5	11.7	11.1	5.9	5.9	11.2	13.8	3.3	2.8	1:4.4	3.1	2.7	.15	4.3	7.7	.8	9.0	9.8
28	3.4	15	57.9	10.9	11.1	5.7	5.5	7.5	16.3	3.6	3.3	1:4.3	3.5	3.0	.18	11.0	21.1	.9	3.7	4.0
28	3.3	10	53.2	14.1	8.5	7.0	6.9	10.7	16.3	3.8	3.3	1:4.3	3.6	3.1	.18	17.1	33.4	.9	2.4	2.6
28	3.1	10	59.8	14.7	20.8	7.1	7.3	10.7	18.9	4.3	4.0	1:4.5	4.3	3.7	.21	16.5	32.1	1.2	3.0	3.2
								Green.												
28	3.0	10	48.8	14.5	0	9.4	6.1	42.7	14.8	3.4	3.0	1:4.2	4.3	2.8	.16	13.7	26.3	.9	2.8	2.9
35	2.8	10	79.2	26.7	0	18.0	7.6	53.3	23.7	5.3	4.7	1:4.3	5.3	3.6	.22	12.6	24.5	1.3	5.0	5.1
21	2.4	10	25.6	24.0	0	5.7	3.2	33.6	10.1	2.3	1.9	1:4.7	4.4	2.7	.18	4.0	7.4	1.2	8.3	7.8
28	2.5	9	54.3	20.1	0	11.4	1.3	49.8	16.4	3.8	3.1	1:4.3	4.9	3.1	.19	4.8	9.2	1.2	9.0	9.3

TABLE XVI.—OLD HENS FED ANIMAL FOOD. LOT XIX.

Thirty-six per ct. of the Protein from Animal Food.

Number of days in period.	Average weight per fowl during period.	Number of hens.	Average per fowl for period.															Dry matter in food per day for each pound live weight fed.	Cost of food for each pound of eggs produced.	Dry matter in food for each pound of eggs produced.
			Mixture 1.	Corn.	Wheat.	Barley.	Oats.	Alfalfa hay.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Numbe of eggs.	Weight of eggs.			
	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.		Ozs.	Ozs.	Cts.	Lbs.
28	6.4	11	72.0	15.5	14.7	7.7	7.7	9.3	20.6	11.6	5.6	1:4.1	4.5	3.9	.25	7.3	15.9	.6	7.8	6.9
28	6.3	11	55.0	11.5	12.0	6.2	6.2	9.3	16.2	9.0	4.4	1:4.1	3.6	3.1	.20	7.1	15.5	.5	6.3	5.6
28	6.0	11	62.7	14.3	14.5	7.2	7.2	9.3	18.5	10.2	5.0	1:4.2	4.1	3.6	.23	14.6	31.5	.6	3.6	3.2
								Green.												
28	5.8	11	55.8	12.7	12.6	5.6	5.6	37.3	16.4	9.0	4.6	1:4.2	4.6	3.2	.20	12.5	27.3	.5	3.6	3.2
28	5.6	11	52.3	12.9	11.4	5.7	5.7	37.3	15.7	8.5	4.4	1:4.2	4.5	3.0	.19	10.6	22.7	.5	4.1	3.7
28	5.6	11	61.2	13.5	16.8	9.1	9.1	40.7	19.0	10.1	5.2	1:4.3	5.4	3.7	.26	10.0	21.3	.7	5.4	4.9
28	5.9	11	70.3	14.3	12.6	5.8	5.8	40.7	19.7	11.1	5.5	1:4.1	5.3	3.7	.26	10.6	22.6	.6	5.1	4.6

TABLE XVII.— OLD HENS FED VEGETABLE FOOD. LOT XX.

A Ration of Vegetable Food Only.

Number of days in period.	Average weight per fowl during period.	Number of hens.	Average per fowl for period. Mixture 2.	Wheat.	Corn.	Barley.	Oats.	Alfalfa hay.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Number of eggs.	Weight of eggs.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound of eggs produced.	Dry matter in food for each pound of eggs produced.
	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.		Ozs.	Ozs.	Cts.	Lbs.
28	5.7	11	69.3	13.1	13.8	7.3	7.3	9.3	19.7	4.4	4.1	1:4.3	4.3	3.7	.20	12.0	24.7	.6	3.9	4.2
28	5.3	11	51.9	13.6	13.2	5.1	6.4	9.3	15.9	3.6	3.3	1:4.4	3.6	3.1	.16	9.8	20.2	.6	4.0	4.2
28	4.9	11	52.2	14.2	10.3	8.6	6.1	9.3	16.1	3.7	3.3	1:4.4	3.6	3.1	.17	10.9	22.1	.6	3.7	3.9
								Green.												
28	4.7	11	52.3	15.3	....	8.9	5.2	37.3	15.2	3.4	3.0	1:4.2	4.2	2.8	.15	4.6	9.5	.6	8.0	8.3
28	4.6	11	47.8	15.6	....	12.0	5.2	37.3	14.7	3.3	2.9	1:4.3	4.2	2.8	.15	5.4	10.2	.6	7.3	7.6
28	4.4	11	47.4	17.7	....	10.9	6.2	40.7	14.9	3.4	3.0	1:4.4	4.4	2.9	.17	5.9	11.5	.7	6.7	6.9
28	4.1	11	51.6	14.1	....	10.2	6.2	40.7	15.3	3.5	3.1	1:4.2	4.4	2.8	.17	4.7	9.2	.7	8.2	8.7

RELATIVE EFFICIENCY AND ECONOMY OF THE RATIONS FOR HENS.

About 13 per ct. more food was eaten and 31 per ct. more eggs were laid by Lot XVII having the ration containing animal meal than by Lot XVIII. During the thirty-two weeks the average egg production per hen was 110.1 eggs for Lot XVII and 84 eggs for Lot XVIII. Eggs from both lots averaged about the same in weight. The amount of dry matter in the food for each pound of eggs produced was 3.7 pounds for Lot XVII and 4.3 pounds for Lot XVIII. The cost of food for each pound of eggs produced was the same for both lots, 4.1 cents, and the food cost per dozen eggs was 5.9 cents.

Lot XIX ate nearly 15 per ct. more food than Lot XX and laid over 36 per ct. more eggs. During the twenty-eight weeks the average egg production per hen was 72.7 for Lot XIX and 53.3 for Lot XX. The eggs from Lot XIX averaged somewhat larger. The amount of dry matter in the food for each pound of eggs produced was 4.3 pounds for Lot XIX and 5.5 pounds for Lot XX. The cost of food for each pound of eggs produced was 4.8 cents for Lot XIX and 5.2 cents for Lot XX. The food cost per dozen eggs was 7.8 cents for Lot XIX and 7.9 cents for Lot XX. With these two lots of older hens which had not been under the effect of similar rations before the experiment began there was no difference in the laying noticeable during the first twelve weeks, but after the cumulative effect of the rations began to be felt the superiority of the one ration for sustained egg production became more evident. A study of the tabulated data will show this.

With the two lots of younger birds, which had been since hatching under the influence of somewhat similarily contrasted rations, the difference in egg production was apparent from the start. This difference was even more noticeable after several months although the lot having the animal food had been laying longer under the influence of the preliminary rations before this experiment began. For short periods during part of the laying

season the vegetable food ration was used as efficiently as the other, but the subsequent decline in egg production was more rapid than under the other ration. It will be noticed by referring to the tabulated data that the birds in Lot XVII were during every period somewhat heavier than those in Lot XVIII. This was due to the actual difference in size and not to accumulation of fat. This difference between the lots had been much more noticeable before they reached maturity. No particular differences were noticed in regard to broodiness or molting.

OBSERVATIONS RELATIVE TO THE EGGS.

During the first few months a cockerel was kept with each of the two Lots XIX and XX. These birds were alternated between the two lots so that any difference in the general fertility of the eggs might not be attributable to any difference in male birds. The eggs from Lot XIX showed a somewhat greater percentage of fertility than those from Lot XX but there was little difference in the vitality of the germs.

During about four months one cockerel was kept alternately with Lots XVII and XVIII. Eggs were examined several times during the season both when they were probably at their best and later when they were poor. On the average there was a large percentage of fertile eggs, there were fewer of the very weak germs, and the proportion of chicks hatched from the tested eggs was greater for Lot XVII.

Two lots, ten in each, of two year old hens were also fed these contrasted rations for a few months, although full data were not collected. One male bird was kept alternately with the two lots. Eggs from the two lots showed the same percentage of fertility, but there were fewer weak germs in the eggs from the lot having the animal food ration and more chicks were hatched from the tested eggs.

Eggs from all the lots were sometimes kept for a long time before use, but contrasted lots were treated alike. Eggs from

none of these lots were so good for hatching as eggs from some hens having practically free run, nor as eggs from some other matings of birds kept confined. No general differences were apparent in the average weights attained by the chicks hatched from eggs from the several contrasted lots, nor in the vigor of the chicks while growing.

There was some difference generally in the size of the eggs in favor of the lots having the animal food. But little difference in the nutritive value of the eggs was found by chemical analysis. Such differences as were found will be later considered in connection with other work. The shells were generally heavier on eggs from those birds having the animal food ration. Twenty tests of the table qualities of the eggs were made by ten different families. Preferences did not all coincide. Eggs from Lots XVII and XVIII were on the average about equally preferred, while a nearly unanimous opinion favored eggs from Lot XIX over those from Lot XX. Opinion seemed to be influenced favorably by the generally darker colored yolks and firmer consistency of the eggs from hens having the animal food. When a preference in regard to flavor was expressed it was nearly always in favor of the eggs produced under the vegetable food ration.

SECOND SERIES OF EXPERIMENTS.

In another series of experiments two lots of chicks were fed for nine weeks and four lots for eleven weeks. Two lots of ducklings were fed for nine weeks and two lots of laying hens for seven months. The contrasted feeding, as in the former experiments, began with the chicks and ducklings when they were one week old and continued until they were ten or twelve weeks old. The same conditions existed in regard to management and accommodations.

RATIONS IN THE SECOND SERIES.

One ration for chicks and hens consisted of wheat, corn and a mixture, No. 3, composed of 27 parts by weight of corn meal,

25 parts of animal meal, 5 parts each of wheat bran and malt sprouts, 3 parts each of wheat middlings and Buffalo gluten meal and 2 parts each of buckwheat middlings and pea meal. The contrasted ration consisted of wheat, corn and a mixture, No. 4, composed of 12 parts of wheat bran, 11 parts of King gluten meal, 9 parts each of malt sprouts, buckwheat middlings and bone ash, 6 parts of O. P. linseed meal, 5 parts of pea meal, 4 parts of corn meal, 3 parts each of brewer's grains and ground flaxseed, and 2 parts of wheat middlings. To every 360 pounds of each mixture one pound of salt was added. The ducklings had wheat bran and corn meal with each of the contrasted mixtures. Green alfalfa was fed to every lot. Sand and coarse grit were liberally supplied to the chicks and ducklings and grit and oyster shells to the hens.

The valuations assumed for the foods have been mentioned on page 78. The average composition of each food used in these experiments is shown in the following table. Special analyses of the green alfalfa and alfalfa hay were not made but the average of many analyses showing the composition of numerous samples fed in previous experiments were used in the calculation of rations. See page 79.

Table XVIII.— Composition of Foods Used in the Second Series of Poultry Feeding Experiments.

Food.	Water.	Ash.	Protein.	Albuminoids.	Fibre.	Nitrogen-free extract.	Fats (ether extract).
	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.	Per ct.
Mixture 3	10.2	12.7	25.1	22.1	3.3	42.8	5.9
Mixture 4	10.4	13.4	22.6	20.7	5.3	41.2	6.6
Wheat	13.4	1.9	11.3	11.0	2.0	69.5	1.9
Cracked corn	13.0	1.3	9.3	8.8	1.3	70.9	4.2
Wheat bran	12.8	6.5	14.1	12.5	10.8	50.9	4.9
Corn meal	11.5	1.4	10.3	9.6	1.4	71.0	4.4

EXPERIMENT WITH CHICKS, SECOND SERIES.

The lots of chicks, XI, XIII and XV were fed the ration containing the animal meal and Lots XII, XIV and XVI were fed the contrasted ration of vegetable foods supplemented by bone ash. Two-thirds of the chicks in Lots XI, XII, XIII and XIV were W. Wyandotte-W. Leghorn crosses and the remainder Leghorns and Wyandottes. The other two lots contained about the same proportion of the cross-bred chicks, the remainder being mostly Wyandottes with a few Plymouth Rocks.

After the chicks in Lots XI and XII were ten weeks old the largest cockerels were removed and the remainder fed for two weeks longer on the same rations. The other four lots were fed until the chicks were twelve weeks old without separating the cockerels. The different lots were fed freely — all the food they would readily eat. The nutritive ratios of the rations were nearly alike, the ratio for the vegetable-food ration being however slightly wider as in the preceding experiments. The contrasted rations in this series were more nearly alike in regard to the relations of the protein, ash and fats to the total dry matter. The vegetable-food ration contained a slightly less proportion of protein and a slightly larger proportion of ash and of fats, but these differences were very small.

The data secured in feeding the six lots of chicks are given in the accompanying tables.

RELATIVE EFFICIENCY AND ECONOMY OF THE RATIONS FOR CHICKS.

The ration containing the animal meal was eaten somewhat more freely. The gains made by the contrasted lots were, however, very nearly equal. Lot XI ate nearly 12 per ct. more food calculated on the basis of dry matter than did Lot XII, Lot XIII ate nearly 16 per ct. more than Lot XIV and Lot XV over 9 per ct. more than Lot XVI. The gain in weight made by Lot XII was less than 4 per ct. greater than that made by Lot XI, the gain made by Lot XIII was nearly 10 per ct. greater than

that made by Lot XIV and the gain made by Lot XVI was about 7 per ct. greater than that made by Lot XV. The amount of dry matter in the food consumed for each pound gain in weight was 4.4 pounds for Lot XI and 3.8 pounds for Lot XII; the amount was 4.7 pounds for Lot XIII and 4.5 pounds for Lot XIV. It was 5.8 pounds for Lot XV and 5.0 pounds for Lot XVI. The figures show that while the rapidity of growth was about the same under both rations, the vegetable-food ration was used more efficiently by the growing chicks. A smaller amount of food was required to produce results equal to those produced by a much larger amount under the ration containing animal food.

The difference in the cost of food was due not so much to the somewhat greater consumption under the one ration, but more to the difference in cost of the two mixtures which constituted half the food in the respective rations. The difference in the food cost of the gain made is therefore due not alone to the somewhat greater efficiency of the one ration but more to the valuation of the different foods necessarily used.

The food cost of each pound gain in weight made by Lot XI was 5.3 cents and of that made by Lot XII 4.2 cents. For Lot XIII the cost was 5.6 cents and for Lot XIV 4.9 cents. For Lot XV the cost was 7.0 cents per pound and for Lot XVI 5.4 cents per pound. In rapidity of growth there was little practical difference, equal weights being reached by contrasted lots at the same age. While at ten weeks of age equal weights had been attained by contrasted lots, at twelve weeks the average for Lot XIII was slightly heavier than that of Lot XIV. The weights of other lots at twelve weeks still bore the same relation.

EXPERIMENT WITH DUCKLINGS, SECOND SERIES.

Of the two lots of Pekin ducklings, Lot C was fed the ration containing animal food and Lot D the vegetable food ration with the bone ash. In the accompanying tables the data in regard to the feeding are given up to the age of ten weeks. After ten

TABLE XIX.—CHICKS FED ANIMAL FOOD. LOT XI.

Thirty-eight per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 8.	Wheat.	Corn.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1	.1	99	1.9	.5	.5	...	.6	.3	.1	1:3.3	.4	.4	.03	.6	2.8	4.9	4.1
14	2	.	98	7.1	1.8	1.8	.6	2.2	1.0	.5	1:3.3	.8	.7	.05	2.4	3.0	4.8	4.0
14	4	.5	97	11.5	2.5	2.5	1.7	3.5	1.6	.9	1:3.2	1.3	1.1	.08	3.3	2.6	5.5	4.5
14	6	.8	96	15.2	3.7	3.8	3.5	4.7	2.1	1.2	1:3.3	1.9	1.5	.11	4.9	2.3	5.1	4.3
14	8	1.2	93	20.2	5.4	5.3	5.4	6.4	2.8	1.6	1:3.3	2.6	2.0	.15	5.6	2.0	6.1	5.1
*14	10	1.7	75	26.6	6.4	6.4	5.2	8.2	3.7	2.0	1:3.3	3.2	2.6	.19	8.9	1.8	4.8	4.1

* After removal of the largest cockerels.

TABLE XX.— CHICKS FED VEGETABLE FOOD. LOT XII.

All Organic Matter in the Ration from Vegetable Food. Bone Ash Added.

Number of days in period	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 4.	Wheat.	Corn.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1	.1	97	1.8	.4	.4	...	.5	.3	.2	1:3.5	.4	.3	.02	.5	2.4	4.7	4.2
14	2	.3	97	6.2	1.8	1.8	.6	1.8	.9	.5	1:3.8	.7	.6	.04	2.2	3.0	4.5	4.0
14	4	.5	95	10.4	2.3	2.3	1.8	2.9	1.5	.8	1:3.6	.2	1.0	.07	3.4	2.5	4.5	4.0
14	6	.8	93	13.7	3.3	3.4	3.6	3.9	2.0	1.1	1:3.7	1.7	1.4	.09	5.2	2.1	4.0	3.6
14	8	1.2	93	17.7	4.6	4.4	5.4	5.2	2.6	1.5	1:3.7	2.3	1.8	.12	6.1	1.7	4.4	4.1
*14	10	1.7	75	22.9	5.7	5.7	5.2	6.7	3.4	1.9	1:3.7	2.8	2.3	.15	8.9	1.6	3.9	3.6

* After removal of largest cockerels.

TABLE XXI.—CHICKS FED ANIMAL FOOD. LOT XIII.

Thirty-seven per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 8.	Wheat.	Corn.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts	Ozs.	Ozs.	Cts.	Lbs.
7	1	.2	86	2.4	.5	.5	.3	.7	.3	.2	1:3.2	.5	.4	.03	.9	3.2	4.1	3.4
14	2	.3	86	5.1	1.4	1.4	1.3	1.6	.7	.4	1:3.4	.7	.5	.04	1.8	2.4	4.9	4.1
14	4	.5	86	9.9	2.4	2.5	2.3	3.1	1.4	.7	1:3.3	1.2	1.0	.07	3.2	2.5	5.0	4.3
14	6	.7	86	14.4	3.6	1.5	3.3	4.3	2.0	1.0	1:3.0	1.6	1.3	.10	3.7	2.2	6.1	4.9
14	8	1.1	85	16.3	4.1	6.1	4.6	5.3	2.3	1.3	1:3.5	2.2	1.7	.13	6.3	1.9	4.4	3.9
14	10	1.5	85	26.2	6.5	6.6	5.3	8.1	3.6	2.0	1:3.3	3.2	2.6	.19	5.8	2.0	7.3	6.2

TABLE XXII.—CHICKS FED VEGETABLE FOOD. LOT XIV.

All Organic Matter in the Ration from Vegetable Food. Bone Ash Added.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 4.	Wheat.	Corn.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs
7	1	.1	86	1.9	.5	.5	.3	.6	.3	.2	1:3.8	.5	.4	.03	.5	0	5.9	5.4
14	2	.3	86	5.4	1.4	1.4	1.3	1.6	.8	.5	1:3.7	.7	.5	.04	2.2	2.6	3.7	3.4
14	4	.5	86	9.0	2.2	2.1	2.3	2.6	1.3	.7	1:3.6	1.1	.9	.06	3.2	2.3	4.2	3.8
14	6	.8	85	8.9	2.3	2.4	3.3	2.6	1.3	.8	1:3.7	1.2	.9	.06	4.3	1.5	3.2	3.0
14	8	1.1	84	14.0	3.4	3.4	4.7	4.0	2.1	1.2	1:3.7	1.8	1.4	.09	5.9	1.5	3.5	3.3
14	10	1.4	83	24.5	6.2	6.2	5.4	7.1	3.6	2.0	1:3.7	3.0	2.4	.16	3.7	1.9	10.2	9.3

TABLE XXIII.—CHICKS FED ANIMAL FOOD. LOT XV.

Thirty-five per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 8.	Wheat.	Corn.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1	.1	61	1.8	.5	.5	.7	.6	.3	.2	1:3.4	.5	.4	.03	.4	3.1	7.2	6.2
14	2	.3	60	6.8	1.6	1.9	1.9	2.1	.9	.5	1:3.4	.9	.7	.05	2.2	3.2	5.2	4.3
14	4	.4	56	9.6	2.5	2.1	3.2	3.0	1.4	.7	1:3.3	1.2	.9	.07	1.3	3.0	12.8	10.1
14	6	.6	54	11.5	2.8	2.9	5.2	3.7	1.7	.9	1:3.3	1.6	1.2	.08	2.8	2.5	7.1	5.9
14	8	.8	53	16.1	4.1	4.1	6.3	5.2	2.3	1.3	1:3.3	2.2	1.6	.12	3.2	2.5	8.5	7.3
14	10	1.1	52	16.6	4.2	4.1	6.5	5.3	2.4	1.3	1:3.3	2.2	1.7	.12	5.2	1.8	5.4	4.5

TABLE XXIV.—CHICKS FED VEGETABLE FOOD. LOT XVI.

All Organic Matter in the Ration from Vegetable Food. Bone Ash Added.

Number of days in period.	Average age of chicks at beginning of period.	Average weight of chicks at end of period.	Number of chicks.	Average per fowl for period. Mixture 4.	Wheat.	Corn.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per chick during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1	.1	61	1.8	.4	.4	.7	.5	.3	.2	1:3.7	.5	.4	.03	.5	2.7	5.9	5.6
14	2	.3	60	5.5	1.4	1.3	1.9	1.6	.8	.5	1:3.6	.7	.5	.04	2.1	2.6	4.0	3.6
14	4	.4	57	9.1	2.0	2.8	3.2	2.7	1.4	.8	1:3.8	1.2	.9	.06	1.9	2.7	7.5	6.7
14	6	.6	56	10.0	2.7	2.8	5.0	3.0	1.5	.9	1:3.8	1.5	1.1	.07	3.1	2.1	5.3	4.8
14	8	.8	55	15.0	2.5	2.6	5.9	4.1	2.2	1.2	1:3.4	1.9	1.4	.09	2.5	2.0	8.1	7.6
14	10	1.1	55	15.4	4.9	4.9	6.1	4.8	2.3	1.4	1:3.9	2.2	1.7	.11	6.1	1.8	4.2	3.9

weeks the growth was much slower although made at a profitable rate for a fortnight or more.

RELATIVE EFFICIENCY AND ECONOMY OF THE RATIONS FOR DUCKLINGS.

There seemed to be no difference in the palatability of the rations. The birds appeared in equally good health under both, and there was no loss in either lot. The ducklings in Lot C grew much faster and ate much more food during all periods of the experiment. As much or more food was eaten at all times by the birds in Lot D in proportion to their size. The consumption of food was 26 per ct. greater for Lot C and the gain in weight 65 per ct. greater.

The dry matter in the food for each pound gain in weight was 3.3 pounds for Lot C and 4.3 pounds for Lot D. The cost of food per pound gain in weight up to ten weeks of age was 8.5 cents for Lot C and 4.1 cents for Lot D. At five weeks of age the average weight of the ducklings in Lot C was 2.5 pounds and in Lot D 1.4 pounds. At eight weeks of age the average weights were 4.5 pounds for Lot C and 2.9 pounds for Lot D. At ten weeks of age the weights were 5.75 pounds for Lot C and 3.7 pounds for Lot D, and at twelve weeks the average weights were 6.4 pounds and 4.7 pounds respectively. The average weight of two pounds was attained by Lot C 1.8 weeks sooner than by Lot D, the average weight of three pounds 2.3 weeks sooner, the average weight of four pounds 3.3 weeks sooner and the average weight of five pounds about a month sooner. The birds in Lot C reached the average weight of six pounds at 10.4 weeks of age. Those in Lot D did not reach this weight while feeding records were kept, but birds from this lot attained later in the season practically the same size as those more quickly grown. Under the vegetable food ration with bone ash the ducklings were able to make a moderate and regular growth and remain in continual good health. This, other lots of ducklings had be-

TABLE XXV.—DUCKLINGS FED ANIMAL FOOD. LOT "C."

Thirty-six per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average age of ducklings at beginning of period.	Average weight of ducklings at end of period.	Number of ducklings.	Average per fowl for period. Mixture 8.	Wheat bran.	Corn meal.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per fowl during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1.2	.6	30	7.9	1.5	3.1	.9	2.5	1.2	.7	1:3.3	1.9	1.6	.11	4.4	3.5	2.7	2.6
7	2.2	1.0	30	12.1	2.4	5.0	.9	3.9	1.8	1.1	1:3.4	2.9	2.5	.17	6.8	3.1	2.7	2.6
7	3.2	1.8	30	18.7	4.0	7.4	2.8	6.1	2.8	1.6	1:3.4	4.7	3.9	.26	12.0	2.8	2.4	2.3
7	4.2	2.6	30	22.6	4.9	9.1	2.8	7.4	3.4	2.0	1:3.4	5.6	4.8	.31	13.5	2.2	2.6	2.5
7	5.2	3.3	30	28.3	5.3	10.7	4.7	9.1	4.2	2.4	1:3.3	7.0	5.8	.38	10.2	2.0	4.2	4.0
7	6.2	3.9	30	26.1	5.3	12.0	4.7	8.7	3.9	2.4	1:3.5	6.9	5.7	.37	9.7	1.6	4.3	4.1
7	7.2	4.7	30	28.9	4.5	10.5	7.5	9.3	4.3	2.5	1:3.3	7.3	5.8	.39	14.0	1.4	3.1	2.9
7	8.2	5.2	30	31.5	7.1	11.7	7.5	10.4	4.8	2.8	1:3.4	8.3	6.7	.43	7.0	1.3	7.0	6.7
7	9.2	5.9	30	23.5	5.6	10.1	7.5	8.0	3.6	2.2	1:3.5	6.7	5.2	.33	11.7	.9	3.2	3.1

TABLE XXVI.— DUCKLINGS FED VEGETABLE FOOD. LOT "D."

All Organic Matter in the Ration from Vegetable Food. Bone Ash Added.

Number of days in period.	Average age of ducklings at beginning of period,	Average weight of ducklings at end of period.	Number of ducklings.	Average per fowl for period. Mixtur 4.	Wheat bran.	Corn meal.	Alfalfa.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Average gain in weight per fowl during period.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound net gain in weight.	Dry matter in food for each pound gain in weight.
	Weeks.	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.	Ozs.	Ozs.	Cts.	Lbs.
7	1.2	.5	29	8.1	1.5	3.2	1.0	2.4	1.2	.7	1:3.7	2.0	1.6	.10	2.7	3.9	4.1	4.3
7	2.2	.7	29	7.2	1.9	3.5	1.0	2.3	1.2	.7	1:3.9	1.9	1.6	.10	3.2	2.7	3.4	3.6
7	3.2	1.1	29	12.3	2.2	4.5	2.9	3.7	1.9	1.2	1:3.7	3.1	2.5	.15	6.4	2.7	2.6	2.7
7	4.2	1.5	29	13.8	2.7	5.4	2.9	4.2	2.2	1.3	1:3.7	3.5	2.9	.17	6.5	2.2	2.9	3.1
7	5.2	2.0	29	16.4	3.1	6.4	4.8	5.0	2.6	1.5	1:3.7	4.4	3.4	.20	6.8	2.0	3.3	3.5
7	6.2	2.2	29	15.9	3.2	6.8	4.8	5.0	2.5	1.6	1:3.8	4.4	3.5	.20	4.6	1.7	4.9	5.2
7	7.2	3.1	29	31.5	5.2	11.7	7.7	9.4	4.9	2.9	1:3.7	8.0	6.4	.38	13.4	2.4	3.2	3.4
7	8.2	3.4	29	26.3	4.6	12.0	7.7	8.1	4.1	2.6	1:3.8	7.2	5.7	.33	5.1	1.8	7.3	7.8
7	9.2	3.8	29	25.7	6.1	8.9	7.7	8.0	4.1	2.5	1:3.7	6.9	5.4	.32	5.3	1.5	8.1	7.2

fore been unable to do on rations wholly of vegetable food or on such rations supplemented by a liberal amount of skimmilk curd. The bone ash appeared therefore to partly supply a deficiency which had existed in some other rations, but it did not bring the ration anywhere near to the efficiency of the ration containing animal meal. The contrasted rations were nearly alike in chemical composition so far as the groups of constituents are *ordinarily* considered in feeding.

EXPERIMENT WITH LAYING HENS, SECOND SERIES.

The two lots of laying hens which were fed the contrasted rations were Leghorns and had been laying well for two or three months before the experiment began. The two lots were alike at the start. The ration containing animal food was fed to Lot XXI and the vegetable food ration to Lot XXII. The hens were liberally fed but not more than was promptly and readily eaten. Chopped alfalfa hay was fed during the first period and green alfalfa during two others. For about three months the hens were allowed to get their green food from grass runs and the amount eaten was estimated from the amount of green forage eaten at other times when it was freely fed. An interrogation point accompanies the statement of amount of green fodder for the periods when it was estimated. The records of feeding and the results obtained are stated in condensed form in the accompanying tables.

RELATIVE EFFICIENCY AND ECONOMY OF THE RATIONS FOR HENS.

The difference in food consumption under the two rations was practically nothing. For the thirty weeks there was only about one-half per ct. difference in the total dry matter of the food. Up to the beginning of the last period the total consumption was exactly the same. The rations were intended to correspond very closely in regard to the proportions of constituents, and this they proved to do, although there were slight differences. The animal

TABLE XXVII.—HENS FED ANIMAL FOOD. LOT XXI.

Thirty-four per ct. of the Protein in the Ration from Animal Food.

Number of days in period.	Average weight per fowl during period.	Number of hens.	Average per fowl for period. Mixture 8.	Wheat.	Corn.	Alfalfa hay.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day	Number of eggs.	Weight of eggs.	Dry matter in food per day for each pound live weight fed.	Cost of food for each pound of eggs produced	Dry matter in food for each pound of eggs produced.
	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs.	Ozs.	Cts.		Ozs.	Ozs.	Cts.	Lbs.
35	3.4	14	79.5	20.9	20.0	23.8	26.5	12.0	6.3	1:3.3	3.8	3.4	.23	24.9	48.0	1.0	2.8	2.5
						Green.												
35	3.3	14	73.0	18.5	18.0	76.2(?)	25.3	11.3	6.1	1:3.4	5.3	3.3	.21	25.0	48.3	1.0	2.6	2.4
35	3.3	13	80.0	19.5	20.1	80.0(?)	27.5	12.3	6.6	1:3.4	5.7	3.5	.23	21.8	46.8	1.1	2.9	2.7
35	3.1	13	71.7	18.2	18.0	86.8(?)	25.4	11.3	6.1	1:3.4	5.6	3.3	.22	17.6	32.8	1.1	3.8	3.5
35	3.1	13	67.2	17.2	17.0	86.8	24.0	10.7	5.8	1:3.4	5.4	3.1	.21	15.9	30.6	1.0	3.9	3.6
35	3.1	13	62.2	15.1	15.3	86.8	22.4	10.0	5.4	1:3.4	5.1	2.9	.19	11.2	22.8	.9	4.7	4.5

TABLE XXVIII.—HENS FED VEGETABLE FOOD. LOT XXII.

All Organic Matter in the Ration from Vegetable Food. Bone Ash Added.

Number of days in period.	Average weight per fowl during period.	Number of hens.	Average per fowl for period. Mixture 8.	Wheat.	Corn.	Alfalfa hay.	Protein in food.	Ash in food.	Fats in food.	Approximate nutritive ratio.	Total food per day.	Dry matter in food per day.	Cost of food per day.	Number of eggs.	Weight of eggs.	Dry matter in good per day for each pound live weight fed.	Cost of food for each pound of eggs produced.	Dry matter in food for each pound of eggs produced.
	Lbs.		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.		Ozs	Ozs.	Cts.		Ozs.	Ozs.	Cts.	Lbs.
35	3.3	15	74.0	18.8	19.1	13.1	22.8	11.7	6.3	1:3.7	3.6	3.1	.19	23.9	42.2	1.0	2.6	2.4
						Green.												
35	3.2	15	68.3	18.3	17.7	70.0(?)	22.1	11.1	6.2	1:3.7	5.0	3.1	.18	23.1	43.5	1.0	2.5	2.5
35	3.2	13	81.6	19.6	19.2	80.0(?)	25.8	13.1	7.3	1:3.7	5.7	3.6	.21	22.9	42.7	1.1	2.9	2.9
35	3.3	13	75.9	18.5	18.9	86.2(?)	24.6	12.4	6.9	1:3.7	5.7	3.4	.21	18.1	33.7	1.0	3.5	3.5
35	3.2	13	76.4	18.2	18.2	86.2	24.6	12.5	6.9	1:3.7	5.7	3.4	.21	17.2	32.3	1.1	3.7	3.7
35	3.2	13	64.6	16.1	16.1	86.2	21.5	10.8	6.0	1:3.7	5.2	3.0	.18	....	14.7	1.0	7.0	7.1

food ration supplied on the average a little more protein and a little less of ash and fats than the contrasted ration.

During nearly six months there was very little difference in egg production, the difference being less than three per ct. in favor of Lot XXI. After this the falling off was more rapid for Lot XXII so that the egg yield for the whole time was about six per ct. greater for Lot XXI. The average number of eggs laid per hen during the thirty weeks was 119.4 for Lot XXI and 112.7 for Lot XXII. For every pound of eggs produced there were 3 pounds of dry matter in the food for Lot XXI and 3.2 pounds for Lot XXII. For nearly six months the proportion of dry matter in the food for each pound of eggs produced was 2.8 pounds for Lot XXI and 2.9 pounds for Lot XXII. Although the cost of food was somewhat more under the animal food ration, the egg yield was enough larger to make the food cost of eggs about alike for both lots. For the whole time the average cost for each pound of eggs was 3.2 cents for each lot. For all but the last period the average was 3.1 cents for Lot XXI and 3.0 cents for Lot XXII. The average food cost per dozen eggs was, for the thirty weeks, 4.7 cents for Lot XXI and 4.6 cents for Lot XXII.

No general difference was noticed in regard to molting.

OBSERVATIONS ON THE EGGS.

Two cockerels were kept, one with each lot, during the first three and one-half months. The birds were alternated between the two lots so that average and general differences in the eggs would appear justly credited to the hens. The eggs from Lot XXI proved better from the breeders' standpoint than those from Lot XXII. Eggs from both lots were sometimes kept several weeks. Five hundred eggs from each lot were examined and incubated. Eighty-six per ct. of those from Lot XXI were fertile, 19 per ct. of the fertile eggs had very weak germs and 77 per ct. of the tested eggs hatched strong chicks. Of those from Lot XXII, 78 per ct. were fertile, 34 per ct. of the fertile eggs had

very weak germs and 64 per ct. of the tested eggs hatched strong chicks. Early in the season some of the eggs from both lots were much better than these average results show and later some were much inferior. The cockerels used were undoubtedly responsible for many fluctuations in fertility of the eggs, for there were pronounced differences consistently following changes of the male birds.

A circumstance was noticed in the later hatches which seems worthy of record for it suggests a difference in the prepotency of the hens in the two lots. The hens used were thoroughbred S. Combed W. Leghorns and the cockerels were pure W. Wyandottes. From Lot XXI almost exactly one-half of the number of chicks hatched (52 per ct.) had the single comb characteristic of the female parent, while all the chicks from Lot XXII had the rose comb characteristic of the male parent. Unfortunately these observations were limited and apply only to about eighty chicks of the later hatches as the opportunity was lost for observing the chicks of the earlier hatches.

No difference in the vigor of the chicks from the two lots while growing was observed.

SUMMARIZED DATA.

With every lot of chicks in the first series (Lots II, IV, VI, VIII and X) having a ration wholly of vegetable origin more food was required to produce a pound gain than by the contrasted lot (Lots I, III, V, VII, IX). On the average for the ten lots about 23 per ct. more food was required.

The two lots of laying hens, XVIII and XX, required on the average about 23 per ct. more food for each pound of eggs produced than did Lots XVII and XIX having animal food.

Lot B of ducklings required about 2.3 times as much food for each pound gain in weight as did Lot A having the unchanged ration containing animal food.

Every lot of chicks in the second series (Lots XI, XIII and XV) having a ration containing animal food required more food

for each pound gain than did the contrasted lot (Lots XII, XIV and XVI) having vegetable food supplemented by bone ash. On the average about 13 per ct. more food was required.

Less than 7 per ct. more food was required by Lot XXII of laying hens for each pound of eggs produced than was required by Lot XXI.

Lot D of ducklings required over 30 per ct. more food for each pound of gain in weight than did Lot C having animal food.

GENERAL CONCLUSIONS.

In some feeding experiments conclusive results can be obtained in a direct manner from a few animals. In other feeding experifents, however, where mixed foods must necessarily be used longer than for a short time, many conditions exist which cannot be subjected to particular control, and the nature of the evidence is so largely circumstantial that conclusions can only be satisfactory when they are based upon data from several feeding trials and a larger number of animals. In these experiments relating to the use of animal food, including the preliminary trials reported in Bulletin 149, 1,000 chicks and 170 ducklings were grown to marketable size; 90 hens and 40 cockerels were used. The results, therefore, not any of which are of conflicting nature, seem to justify certain conclusions.

In general, rations containing animal food appear more palatable than rations of somewhat similar chemical composition consisting wholly of vegetable food. Rations in which the lack of palatability was overcome by using an unusual variety of grain foods were inferior for growing chicks and laying hens and decidedly inferior for ducklings to rations in which nearly one-fifth of the dry matter was supplied by animal food. After the period of most rapid growth had passed and the young birds approached maturity the difference in the efficiency between such rations rapidly disappeared.

Although it was found possible, when using a large number of foods in contrasted rations of these kinds, to have the ordinary groups of organic compounds in approximately equal proportions there was always a much larger amount of mineral matter in the one ration owing to the bone of the animal meal. So there was sometimes nearly three times as much phosphorous in the one ration as in the other. Calculating all the phosphorous as phosphoric acid, there was in the animal meal ration fed to chicks and hens generally about 3.9 per ct. of phosphoric acid, while in the ration of vegetable origin there was about 1.4 per ct. In the contrasted rations for ducklings there were 4.0 per ct. and 1.9 per ct. of phosphoric acid, respectively.

By using bone ash in another series of experiments, the amount of phosphorus was made to equal and sometimes slightly exceed that in the animal food ration, although all the organic matter was still derived from vegetable food. There was in the animal food ration fed to chicks, phosphorus equivalent to about 3.9 per ct. of phosphoric acid and in the contrasted ration to about 4.0 per ct. The animal food ration for ducklings contained about 3.6 of phosphoric acid and the vegetable food ration about 4.0 per ct. Both rations for laying hens contained about 3.6 per ct. of phosphoric acid. Practically the same relative amounts of protein, fats and carbohydrates existed in the contrasted rations. The vegetable food ration, thus supplemented by the mineral matter of bone ash, when fed to chicks, proved fully equal to the ration containing animal meal, so far as rapidity of growth was concerned. In economy it was even somewhat superior, for considerable less food was required for equal results. For laying hens the rations were equal in efficiency for some months, but the ration containing animal food proved somewhat more enduring in its effects. With ducklings the ash-supplemented ration of vegetable food proved decidedly inferior to the corresponding ration containing animal food.

From these results it appears that rations containing a necessary amount of protein and having the relation of the ordinarily

considered constituents satisfactory may be inferior because of a lack of mineral matter, probably phosphates.

Not enough data are now available to show to just what extent the deficiency of lime in the food for the younger chicks may have been responsible for inferior results. With laying hens, lack of lime could not have affected the results considered; for oyster shells were freely supplied, and it has been shown (see Bulletin No. 38) that such material can make good the frequent deficiency of lime.

It appears also that, while a cheaper vegetable food ration can sometimes be made to equal or surpass in efficiency a ration containing animal food by supplementing it with suitable mineral matter, there are plain limitations to its economical use. For laying hens some animal food appears necessary for continued good results. Ducklings without an abundant supply of animal protein in the ration, together with a liberal proportion of mineral matter, seem unable to make any approximation to their normally rapid and most profitable growth.

Although bone ash was used to make good an assumed deficiency in one ration and proved an efficient addition for the purpose, it should not be inferred that its purchase for feeding is to be generally recommended. It was necessarily used to obtain information. Bone ash in the market is expensive. The same amount of mineral matter can be obtained much cheaper in fresh bone or animal meal, of which foods it constitutes an important part. In some instances, of course, dry bones, where no facilities exist for grinding, or green bones in questionable condition, can be safely and economically used when charred or reduced to ash. The very desirable organic matter associated with fresh or cooked bones should not be wasted.

REPORT

OF THE

Department of Bacteriology

H. A. Harding, *Bacteriologist.*
L. A. Rogers, *Student Assistant.*

Table of Contents.

REPORT OF THE BACTERIOLOGIST.

THE EFFICIENCY OF A CONTINUOUS PASTEURIZER AT DIFFERENT TEMPERATURES.*

H. A. Harding and L. A. Rogers.

SUMMARY.

These tests were made by passing mixed whole milk through a Danish continuous pasteurizer. At 70°C. (158°F.) the efficiency of the continuous pasteurizer varies greatly from day to day. Tests upon 14 different days gave an average of 15,288 living germs per cubic centimeter left in the pasteurized milk, with a maximum of 62,790 and a minimum of 120 germs.

At 80° C. (176° F.) the reduction in germ content is both very uniform and very great. Tests upon 25 different days gave an average of only 117 living germs per cubic centimeter in the pasteurized milk, with a maximum of 297 and a minimum of 20 germs.

At 85° C. (185° F.) the average reduction is not more marked than at 80° C. but the range of variation is less. This temperature has the added advantage, according to Dr. Bang, of removing the danger from germs of tuberculosis in the milk.

Even when the whole milk was heated to 85°C. the butter did not have a permanent cooked flavor.

INTRODUCTION.

An inquiry into the laws which underlie any of the complex commercial processes will progress slowly if each step is deter-

* Reprint of Bulletin No. 172.

mined with a thoroughness that allows of safe generalization from the data obtained.

In order that the reader may see the relation of this piece of work to the problem that is being studied, let the following facts be borne in mind.

THE DANISH SITUATION.

Dairying is one of the principal industries of Denmark and during the past two decades the government has fostered it both by the equipment of experts to study its problems and by protective legislation.

In 1890 Dr. Storch announced that, by changing the kind of bacteria that grow in ripening cream, he was able to change the flavor of the butter.

Dr. Bang, after studying the conditions under which tuberculosis was distributed among cattle, perfected a system of separating the diseased animals from the healthy ones and gradually replacing the former. In carrying out his plan, the feeding of calves upon the skim milk brought from the creamery was found to be a source of danger, but this could be removed by heating the milk momentarily to 85°C. (185°F.).

As the result of these and other investigations, there has spread over Denmark a peculiar method of making butter — a method so successful that, to-day, Danish butter is a standard of excellence wherever it is known.

Cleanliness in all details and an intelligent appreciation of the relation of bacteria to butter-making are widespread, but the key-note of their system is preparation of the starter itself and the cream to receive the starter.

By a starter they rarely mean the mixture of bacteria, desirable and undesirable, which commonly receives that title in New York. They mean a mixture of known kinds, each of which has been found desirable in itself. This united action of several species gives a better flavor to the butter than could be obtained from any single species.

This mixture of germs, when received from a laboratory, is introduced into milk that has been first heated to near the boiling point for 2 hours to kill other bacteria and then cooled below blood heat. This starter is propagated from day to day with so much care that at the end of four to six weeks, when it is finally rejected for a new one, the usual fault with it is merely a too sharp flavor of acid.

The preparation of the cream begins with cleanliness in the barn. Either the whole milk or the cream after separation is heated to free it of objectionable forms before receiving the starter. This heating is only momentary and various temperatures are advocated — those from 70° C. (158° F.) to 95° C. (203° F.) having been used. After heating, the cream is quickly and thoroughly cooled. Formerly cream was heated after separation, both for economy and because of less opportunity for after-contamination.

A knowledge of the increase in feeding value produced by prolonging the period of sweetness, and, later, a desire to prevent the spread of tuberculosis among their calves, caused the skim milk to be heated above 85° C. (185° F.). Since it has been found that the capacity of the separator is increased by skimming at high temperatures and that whole milk can be heated to 90° C. (194° F.) without injury to the flavor of the butter, there is a tendency toward a single heating of the whole milk.

The points of excellence claimed for the Danish product are uniformly good quality and the property of holding its flavor for long periods.

THE AMERICAN SITUATION.

Butter is now selling at from 14 to 28 cents per pound, with less than 15 per ct. of the product bringing the latter price. The quality of the best butter is above reproach, but the lamentable thing is the lack of quantity of such butter. So great is this lack

that during at least a portion of the year it is impossible to buy first-class butter in many of the moderate-sized cities in this, the greatest dairy State in the Union.

These facts show that there is abundant room for improvement, and anything that will raise the average quality of the product will be gladly welcomed, both by the dairyman and the consumer.

After the Danish success became an established fact, Americans attempted to copy their methods, but thus far the results have not been up to their expectations. Tests carried on by the Agricultural Experiment Stations of Wisconsin and Pennsylvania, as well as by the Department of Agriculture at Washington, failed to show that there is any financial gain to be derived from the process when practiced as usually recommended.

Believing that the above failures are due to some of the modifications that the system has undergone in being brought from Denmark to America, this Station has undertaken to follow the process step by step, hoping to find the proper American conditions under which we can not only make a more uniform product, but one that will be sufficiently improved to justify the additional expense in preparation.

The solution of this problem calls for the co-operation of a number of the departments of the Station and will require considerable time; hence, it is proposed to issue the results in a series of bulletins, of which this is the first. While the Bacteriological Department assumes the responsibility for the statements contained in this bulletin, much credit is due our Dairy Expert, Mr. Geo. A. Smith, whose wide experience in dairy matters has materially contributed to the success of the practical side of the work.

WHAT IS MEANT BY PASTEURIZATION.

As long ago as 1782, a Swedish chemist, Scheele,[1] found that after immersing bottles of vinegar in boiling water for a time, the

[1] Hansen, Emil. Chr. Practical Studies in Fermentation, p. 158.

vinegar would not become turbid or spoiled as long as it was kept carefully closed.

Early in the nineteenth century Appert[2] applied this idea of heating inclosed fluids to prevent fermentative changes to the preservation of fruits, vegetables, soups, milk, fruit juices, wine and beer.

A half century later Pasteur turned this knowledge of the effect of heat in delaying fermentation to practical account in combating some of the undesirable fermentations of wine and beer, with such success that the process has been called pasteurization in his honor. Our present methods of canning fruit and vegetables are probably the result of the early discoveries. The application of heat in this way had become such a household matter by the time the process received this special title that the name was not carried over to the ordinary househould heating and a can labeled "Pasteurized Peaches" would to-day be quite a puzzle, although from its manner of preparation it can justly claim that title.

Pasteurization, then, is simply the application of heat to check the activity of fermentation. The temperature used depends upon the substance treated and the end to be attained. The effect upon germ life will vary both with the degree of heat and the length of exposure. The same results can be secured in the killing of *Bacillus tuberculosis* when the milk is heated at 60° C. (140° F.) for 30 minutes or at 85° C. (185° F.) for a very short time.

PASTEURIZATION CONFUSED WITH STERILIZATION.

Sterilization is a good word that has been debased by popular usage. In its true sense it means the total destruction of life. It is often used to mean anything from a simple warming to a thorough boiling. Such words are best used in their true sense

[2] Loc. cit., p. 159.

or not used at all. It should be remembered that some of the organisms which are often found in milk will successfully withstand boiling for some hours and the sterilization, in the true sense, of any commercial quantity of milk at a single heating is a practical impossibility unless temperatures above that of boiling water are used.

THE TWOFOLD APPLICATION OF PASTEURIZATION TO MILK.

The subject of the pasteurization of milk has been presented to the American public with reference to two distinct problems — the sanitary milk supply of cities and the production of uniformly good butter.

While heat is applied in both cases the methods of application which have been found most successful in each are radically different and an attempt to accomplish either object by the other process has not yet been shown to be practical. The first method is too slow and expensive to be adapted to butter making and the second plan when carried on at a temperature sufficiently high to kill the tubercle bacillus gives an objectionable flavor to the milk. Fortunately this flavor does not remain in the butter.

THE DISCONTINUOUS OR HOUSEHOLD SYSTEM.

About ten years ago when the use of tuberculin was bringing home the alarming prevalence of tuberculosis among our dairy cows and the danger of transmission of the disease to invalids and children through milk seemed self-evident, pasteurization was brought forward as a safeguard from this danger. In this method the milk was heated at a definite temperature for a definite length of time.

At first 67.3°C. (155°F.) for 20 minutes was advocated, but owing to the change brought about in the viscosity of the milk and

cream by exposure to this temperature, heating to 60°C. (140°F.) for 30 minutes is now coming more into favor. According to the researches of Dr. Theobald Smith,[3] 15-20 minutes at 60°C. (140°F.) is sufficient to kill the tubercle bacillus provided the milk is kept stirred so as to prevent the formation of a pellicle at the surface. Higher temperatures and a shorter time would give the same result, but when the temperature of 70°C. (158°F.) is passed the milk takes on a disagreeable, cooked taste. This is largely due to an oxidation of some of the components of the hot milk and it is possible that in the future a way may be found of avoiding this flavor.

The main feature in the discontinuous process is the removal of the danger from disease and this applies not only to tuberculosis but to all other germ troubles which are liable to gain access to the milk before it is heated. The keeping quality of the milk is much improved, especially if proper attention is given to keeping it cool after treatment and the effect of the carelessness and lack of cleanliness which are often prevalent at the barn is in a measure removed. A very commendable practice exists of passing the milk through a separator and remixing the milk and cream before pasteurization. This removes a large part of the hair, excrement, etc., which is so common in the ordinary milk supply of cities.

This method of handling milk for immediate consumption is in successful operation in a number of cities on a large scale. It has much to commend it and when done in a large way it does not increase the cost of production more than a small fraction of a cent a quart.

THE CONTINUOUS OR DANISH SYSTEM.

When the Danish system of butter making was introduced into America pasteurization came as a necessary part of it, but in this case the principal object was the fitting of the cream to receive

[3] Journal of Experimental Medicine, 4: 217–233 (1899).

the starter of selected bacteria so that the desired flavor might be always obtained.

The problem that presents itself is not different from that which confronts every farmer who attempts to grow a field of oats. If he sows his seed upon land already filled with rapidly growing clover, Canada thistles and ragweed his chances of a good oat crop are poor. If he first fits his land and kills off the other plants the oats will have a better chance. To make a success of this it is not necessary to kill off every weed in the field for if the oats are much in the majority and get the start of the others they will control the situation and suppress the weeds.

The bacteria are plants of more simple form than those in the above illustration, but they obey the same laws of competition in growth. If conditions are so arranged that the starter when added to the cream finds the same filled with rapidly growing enemies, the effect of the starter will be largely or wholly lost; while if it is added to cream from which all or nearly all of its competitors have been removed, the starter will assume control of the situation and suppress its enemies.

In the Danish machine the milk is introduced at one end of a cylinder surrounded by steam and flows continuously from the other end having been momentarily heated to the temperature desired.

The temperatures used have had an upward tendency and since Dr. Bang announced that when working with tuberculous cows furnishing the diseased germs in their milk the milk was rendered harmless when passed through one of these machines at 85° C. (185° F.), this has been taken as the Danish minimum legal temperature for heating all the by-products that are to be returned to the farm for feeding purposes.

In a country where the most determined effort is being made to stop the spread of tuberculosis among cattle the value of this protection to a dairyman who has succeeded in freeing his own herd from the contagion, but yet is compelled to raise his calves

upon mixed milk brought from the creamery, should not be overlooked.

In this as in their other acts regarding the suppression of tuberculosis the Danes have shown a laudable moderation and consideration of the rights of all concerned. The legal enactment as to the temperature to be used was not made until the pasteurizing process had been voluntarily adopted and the necessary machinery installed in practically every creamery in the country.

The American promoters of the Danish method, knowing from their previous experiences with the other form of pasteurization that a heating above 70° C. (158° F.) produces a disagreeable flavor in the milk, were either not willing to trust the practical experience of the Danes or hopelessly confused the two problems and recommended 67.3° C. (155° F.) to the American experimenters when the Danish practice is to employ a temperature at least 12.7° C. (25° F.) higher.

The points in which their reasoning went astray were two: First, the cooked taste in milk, at least for the most part, is not a matter of absolute temperature at which the milk is heated, but rather the result of an exposure of hot milk to oxygen. Milk that has been highly heated in a Danish pasteurizer and immediately and thoroughly cooled as is their practice has surprisingly little of the cooked taste. Second, the cooked flavor does not attach itself tenaciously to the fat of which the butter is almost exclusively prepared and butter made from highly heated milk that may have a slightly cooked taste immeditely after churning losses this objectionable flavor in a very short time.

Believing that a failure to properly heat the milk might be a factor in the lack of success of past American experiments our investigations began with this point.

THE PROBLEM STUDIED.

The objective point was to determine the effect upon the germ-life when milk was passed through a continuous pasteurizer at

different temperatures. So far as data were at hand this had been done but twice in America. Both of these tests had been carried out at about 70° C. (158° F.) and the trials were too few in number and the results too contradictory to form a safe basis for generalization.

At the Wisconsin Station[4] it was found that, while there was considerable variation in the effect of a heating of 67.3°–74° C. (155°–165° F.), in some cases as many as 40 per ct. of the bacteria survived and in the tests published this number remaining amounted to over 2,000,000 germs per cubic centimeter.

A different kind of continuous machine was used at the Pennsylvania Station[5] and no numerical results were given, but it was stated that "Heating to this temperature 67.3°–70° C. (155°–158° F.), for this length of time, as was found by culture plates, destroyed few, if any, of the bacteria present in the milk."

Since 70° C. (158° F.) is the lowest temperature which is generally recommended for continuous pasteurizing this was taken as a starting point in our work and when the effect of this temperature had been observed higher degrees were used.

MACHINE USED.

We are indebted to D. H. Burrell & Co., Little Falls, N. Y., for the loan of a continuous pasteurizer made by Konstantin Hansen & Schröder, Kolding, Denmark. This has a rated capacity of 2,500 pounds of milk per hour heated to 70° C. (158° F.)

The accompanying drawing of a cross section (Plate II) explains the essential parts of the machine. The milk enters at the bottom into a central milk chamber. Here it is set in motion by the stirrer revolving 300 times per minute, which spreads the milk out in a thin layer against the wall and finally expels it at the tangential milk outlet above. This outlet has a lateral open-

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[4] Pasteurization as Applied to Butter Making, Wis. Agr. Exp. Sta. Bul. 69.
[5] Heated Milk for Butter Making, Penn. Agr. Exp. Sta. Bul. 45.

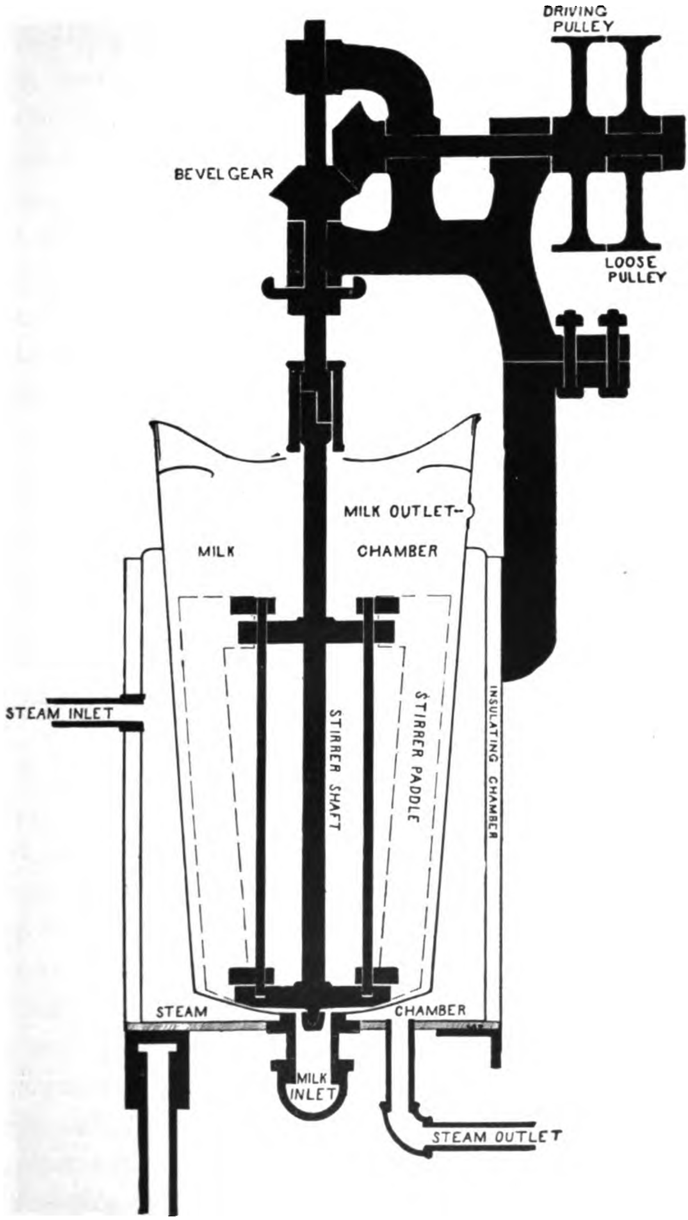

Plate II.—Vertical Section of Continuous Pasteurizer.

ing for receiving the thermometer. As the milk is spread out in this thin layer it quickly takes up the heat from the steam chamber surrounding it.

The temperature of the milk is controlled by changing either the valve admitting the steam or the valve regulating the milk flow. A slight change in either of these valves produces a quick response in the mercury column of the thermometer. Usually the milk valve was set to admit about all the milk that could be heated to the desired degree and the slight variations in temperature were controlled by changing the steam valve.

METHOD OF WORK.

In the manipulation of the machine at the different temperatures the effort was always made to give it a fair chance to show what could be expected of it when handled in the average creamery at that temperature. Our ability to give it a fair trial increased as we became familiar with the machine and its manipulation.

The first requisite was a method of regulating the flow of milk and steam so that the temperature might be held constant. When received, the machine was provided with a float intended to control the flow of milk automatically. After testing it in a variety of ways for some weeks it was condemned as too clumsy for our purpose and was removed.

As finally arranged a supply tank placed sufficiently high to give a good fall was connected directly with the base of the pasteurizer and the flow regulated by a hand valve. This brought the milk and the steam valves near together where one man could reach both and still watch the thermometer. The maximum variation, which rarely exceeded 10° C., usually occurred at the beginning of the process before the valves were properly adjusted. This having been accomplished the desired temperature could be maintained with very little variation.

In order to make the control of the temperature as well as the collection of the desired data more accurate the milk was thoroughly mixed in a tempering vat before starting the machine. The arrangement of the apparatus will be better understood by referring to Plate III.

DATA COLLECTED.

In the Dairy the interest centered upon the temperature used and in the Laboratory upon the numerical content of germs in the milk before and after heating. A large amount of data was collected in both places bearing upon a number of points. Notes were taken upon the age, weight, initial temperature and acidity of the milk, the steam pressure in the boiler, the rate of the pasteurization and the maximum, minimum and pasteurizing temperature employed.

Age.— With age there is an increased growth of bacteria and a larger number of spores present. This is what makes the successful pasteurization of milk over 24 hours old so difficult. During a large part of the time the mixted milk was made up of portions 4, 12, 24 and 36 hours old.

Weight.— This varied considerably but averaged 350 lbs. As the machine while in operation contained only about five pounds of milk and all that was really necessary was to hold the temperature at the desired point at the time of taking the sample this was quite enough for our purpose.

Initial temperature.— The termperature of the mixed milk was noted in the tempering vat. For the most part our milk was brought to about 26° C. (78.8° F.) as being a high average temperature for summer conditions. As received ordinarily in creameries in this State milk varies from near the freezing point in winter to 35° C. (95° F.) in rare cases in summer.

The temperature of the milk as it enters the pasteurizer exerts an influence upon the amount that the machine can heat to a desired degree.

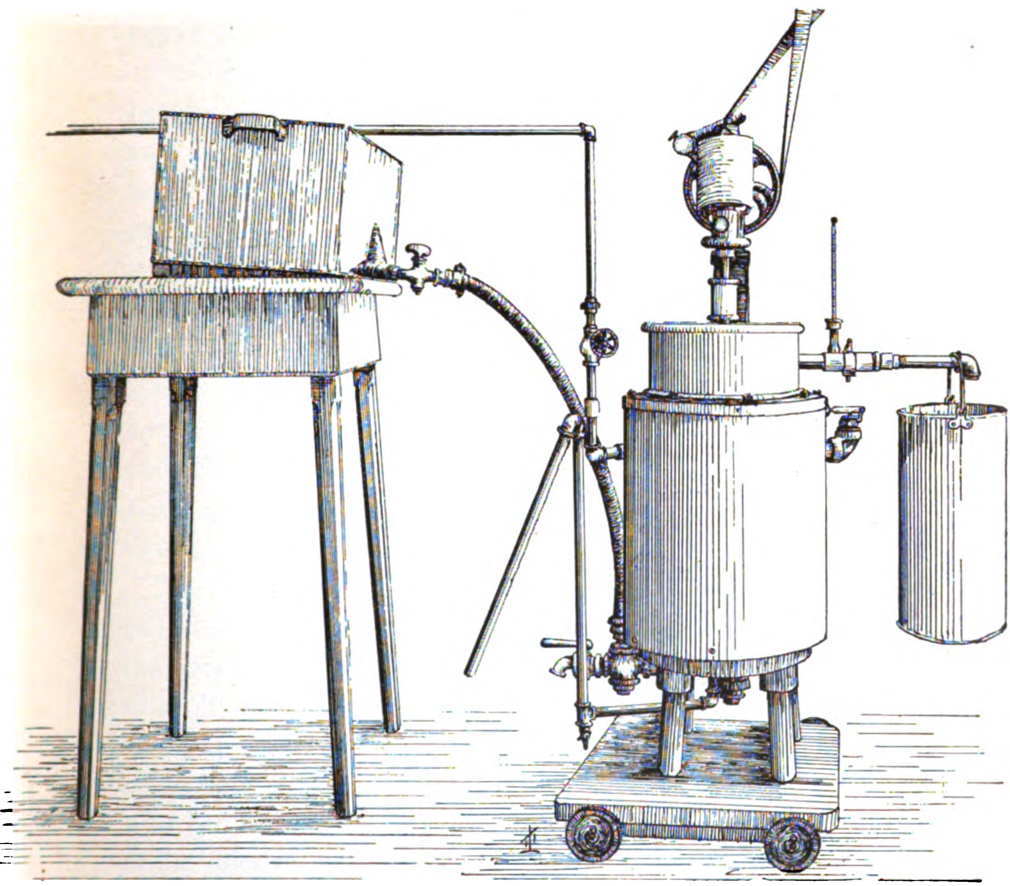

Plate III.—Arrangement of Milk Receiver and Pasteurizer.

Acidity.— As the result of experience in the pasteurization of milk by the discontinuous method it has been found impractical to attempt to pasteurize milk intended for immediate consumption when the acidity is over 0.2 per ct. calculated as lactic acid. During a considerable portion of the time our mixed milk has had an acidity above this figure.

The custom of expressing acidity in milk by percentages of lactic acid has little to recommend it other than that it is common practice. It is a well-known fact that a part of the reaction called acidity is due to the union of the alkali with the casein and that lactic acid is only one of a number of acids found in milk.

The fact always determined is the neutralization as indicated by phenolphthalien of a certain amount of normal solution of alkali. In our results this observed fact is expressed by the number of cubic centimeters of normal alkali neutralized by a litre of milk (N/L). For convenience of comparison the per ct. of lactic acid erroneously assumed from this data is given in parenthesis.

The acidity of our mixed milk ranged from 18.9 N/L (0.17 per ct.) to 40 N/L (0.36 per ct.) and during a considerable portion of the time it was above 22.2 N/L (0.2 per ct.). Thus the conditions of acidity under which the pasteurizing was done were not what would be considered ideal, but rather those which would be found in an average creamery. As the acidity of the mixed milk approached 40 N/L (0.36 per ct.) a considerable layer burned fast to the sides of the milk chamber in the pasteurizer and the accumulation in the separator bowl was increased.

On Feb. 7 the milk with an acidity of 35.5 N/L (0.32 per ct.) was pasteurized at 85° C. (185° F.) very successfully; but the next attempt with whole milk having an acidity of 40 N/L (0.36 per ct.) quickly accumulated a layer on the walls of the pasteurizer and clogged the separator bowl after passing only about 80 pounds of milk.

Steam pressure.— The pasteurizer was connected by a ¾-inch pipe directly to the high-pressure steam pipe. As will be noticed in the diagram Plate II, the steam had a free outlet at a point nearly opposite to the inlet, so that there was at no time any appreciable pressure on the pasteurizer itself. On the contrary, the steam was nearly all condensed and there was rarely any waste, even when the steam valve was opened to its full capacity.

The steam pressure given in the tables is that in the 30 horse-power boiler and was noted as one of the possible factors in the great variation in rate of operation on different days.

Rate.— The amount of milk which a pasteurizer will heat to a given temperature in a given time is important from the practical standpoint.

In order to minimize the variation in temperature to which the milk was exposed and to determine the rate more accurately, it was our custom to add water to the supply tank and when everything was running at full speed and the last of the water was leaving the tank to add the milk and note the time. After all of the milk had been added and just as the last was leaving the tank the time was again noted. The interval was taken as the time required to handle the milk. Since the amount of milk at any one time between the milk valve and the milk outlet was only about 5 pounds, the error was not great.

As one would expect, the rate varies with the pasteurizing temperature. The machine was expected to handle 2,500 pounds an hour at 70° C. (158° F.), and would do even more under favorable conditions. In our experience, it did not much exceed 2,100 at 80° C. (176° F.), and handled less at 85° C. (185° F.). It will be noticed that the rate at 80° C. ranged from as low as 900 to a little over 2,100 pounds per hour. This extreme variation is due to a number of factors, among which are variations in steam pressure and initial temperature and the cooking of the milk on to the walls of the pasteurizer. This layer of cooked material not

only acted as an insulator between the milk and the source of heat, but also encroached upon the interval between the revolving stirrer paddles and the wall, forming a rough surface along which the milk must pass. The fact that the machine was not permanently placed and lacked in rigidity was also a contributing factor to the above variations.

Pasteurizing temperature.— As soon as the milk enters the bottom of the machine it takes up heat from the steam jacket and its temperature rises to the highest point just as it reaches the milk outlet. The temperature at this point is measured by a thermometer inserted in the outlet and constitutes the so-called "Pasteurizing Temperature," although the milk really attained this degree only momentarily. As soon as the milk passes from the machine the temperature falls with a rapidity depending upon the surroundings.

TAKING SAMPLES.

The samples of unpasteurized milk were taken from the tempering vat after the milk had been thoroughly mixed. The only exception to this was during the earlier part of the work, when they were taken from the supply tank just before taking the samples of pasteurized milk from the machine.

The samples of pasteurized milk were taken from the milk outlet after sufficient had passed to remove the effect of the bacteria contained in the water used in starting the machine and in the machine itself. Care was taken to secure samples while the machine was running steadily at the desired temperature.

The samples of about 150 cubic centimeters each in sterile flasks were set into a room at 1.5° to 4.5° C. (35°–40° F.) until the pasteurization was ended, when they were taken to the laboratory on the floor above and the quantitative analyses made.

BACTERIOLOGICAL TESTS.

Method of dilution.— One c. c. of the unheated milk was added to 9 c. c. of sterile water and the two thoroughly mixed. This

process was repeated and a small fraction of a c. c. from the second dilution was added to the culture medium.

Cultures were made in Petri dishes having an internal diameter of 91-92 mm. For the sake of convenience in counting and to prevent the inhibiting effect of closely-crowded colonies, the aim was to so arrange the dilution that the growth would be about 500 colonies to the plate. In the case of the pasteurized milk, no dilution was necessary, but a measured fraction of a cubic centimeter was added directly to the nutrient media.

Media used.— The tabulated results given below were all obtained upon lactose agar made neutral to phenolphthalein with sodium hydroxide and containing 2 per ct. lactose and 1.7 per ct. agar. Agar was chosen in preference to gelatin, because in some previous work of a similar nature at the Wisconsin Station it was found that agar at 28° C. (81.5° F.) gave higher numerical results than gelatin at room temperature. Among the substances now available, there seems to be none that will call out all the individual germs when left at any one temperature.

It is not maintained by the authors that the numbers given below represent the exact number of organisms present either in the pasteurized or unpasteurized milk. All that is hoped for is that they are a close approximation and that having been taken under similar conditions may be found to be directly comparable.

Incubating temperature.— The plates were placed in an incubator at 30° C. (83° F.) and counted at the end of 48 hours. This temperature was believed to be near the optimum for the growth of most of the germs present and the time was thought to give maximum returns with a minimum amount of error. An exposure at higher temperature caused a rapid drying of the plates and one for a longer time did not usually give higher results, while the rapid spreading of superficial colonies made the counting uncertain.

Growth at room temperature required so much longer time as to complicate the work and the rapid multiplication of certain proteus forms made an accurate count very difficult.

When plates that had been kept 48 hours at 30° C. were left 3-5 days at 21° C. (70° F.) there was a small average increase on the second count. This indicates that some of the organisms present in the milk did not thrive at the higher temperature.

The above results obtained from tests upon 14 days at 70° C. (158° F.) illustrate the uncertainty of the pasteurizing action at that temperature and in this particular quite agree with the results on 15 previous days when preliminary trials were being made. They also show what misleading conclusions might be drawn when generalizations are made after one or two observations.

It should be remembered that in any heating of the milk the most desirable class of acid formers will be among the first to be killed and the residue is composed of germs not likely to improve the flavor of the butter. Just how many of this class of bacteria may be left in the milk without impairing the quality of the product, like the problem of how many weeds can be left in the field without detriment to the crop, is not clearly understood and a conservative disposition would favor their reduction to the lowest practical limits.

A most important fact shown is that 70° C. (158° F.) lies near the lower limit of the killing effect of heat applied in this way. When operating a pasteurizer in a practical way, temporary reductions of temperature are almost certain to occur, and if this reduction goes much below 70° C. the killing effect upon bacteria will be very slight.

The results of pasteurizing at 80° C. (176° F.) show a surprising reduction in the germ life and this reduction was accomplished with very slight variation on each of the 25 days tested. These 25 tests gave an average of only 117, with a maximum of 297 and a minimum of 20 living germs per c. c. in the pasteurized milk.

Comparing this average of 25 determinations made after continuous pasteurization with 6,140, the average number of germs

TABLE I.—WORKING CONDITION AND RESULTS OF CONTINUOUS PASTEURIZATION OF MILK AT 70° C.

Date.	Age of milk.	Weight of milk.	Initial temperature.	* Acidity.	Steam pressure on boiler.	Rate(Lbs per hour)	Unpasteurized. Dilution.	Unpasteurized. Colonies on plate.	Unpasteurized. Total germs per c. c.	Pasteurized. Dilution.	Pasteurized. Colonies on plate.	Pasteurized. Totel germs per c. c.	Average. Unp.	Average. Past.
	Hours.	Lbs.	Dg. C		Lbs.									
Aug. 19	....	...	..	....	.....	1776	1– 280	121	33,880	1– 8 1-3	487	4,058	41,300	4,779
	....	...	..	....	.....	....	1– 140	348	48,720	1– 5 1-5	1058	5,500	....	......
22	....	...	..	....	.....	1560	1– 270	294	79,380	1–28	1068	29,904	83,362	23,898
	....	...	..	....	.....	....	1– 135	647	87,345	1– 9 1-3	1917	17,892	....	......
23	....	...	..	....	.....	1104	1– 270	96	25,920	1–13 1-2	63	850	28,417	995
	....	...	..	....	.....	....	1– 135	229	30,915	1– 6 3-4	169	1,141	....	......
24	....	...	..	....	.....	1356	1– 270	147	39,690	1–24	507	12,168	41,512	13,032
	....	...	..	....	.....	....	1– 135	321	43,335	1–12	1158	13,896	....	......
25	....	...	..	....	.....	1434	1– 260	300	78,000	1–24	40	960	78,975	920
	....	...	..	....	.....	....	1– 130	615	79,950	1– 8	110	880	....	......
28	....	...	..	....	.....	2118	1– 250	1,950	487,500	1–26	668	17,368	442,812	17,628
	....	...	..	....	.....	....	1– 125	3,185	398,125	1–13	1376	17,888	....	......
29	....	...	..	....	.....	1872	1– 280	40,977	11.473,560	1–14	4485	62,790	11,473,560	62,790
Sept. 5	....	...	..	....	.....	2286	1– 250	21,688	5,422,000	1–24	715	17,160	5,422,000	16,878
	....	...	..	....	.....	....	......	......	....	1–12	1383	16,590	....	......
12	....	...	..	....	.....	2508	1–1250	22	27,500	1–62	258	15,996	23,237	15,936
	....	...	..	....	.....	....	1– 575	33	18,975	1–42	378	15,876	....	......
26	....	...	..	....	.....	1266	1– 480	40	19,200	1–26	49	1,274	38,400	1,096
	....	...	..	....	.....	....	1– 240	240	57,600	1–17 1-3	53	918	....	......
Dec. 30	36–24	367	21	21.5	65–45	2934	1– 300	66	19,800	1–14	21	294	27,900	287
	12–4	...	..	(0.193 %)	.....	....	1– 150	240	36,000	1–28	10	280	....	......

Jan.	2	48–36	494	20	20	40–55	1740	1– 383	41	15,708	1–25		2	50	19,814	120
		24–12–4	...	..	(0.18 %)	.....	....	1– 230	104	23,920	1– 5		38	190	....	......
Feb.	2	36	364	25	25	60–60	2424	1–4200	124	520,800	1– 5		3250	16,250	637,350	17,062
		24–12	...	..	(0.20 %)	.....	....	1–2100	359	753.900	1– 2	1-2	7150	17,875	....	......
	5	36	388	27	26	65–60	2328	1–2000	2,697	5,394,000	1–26		[illegible]75	59,150	5,703,000	38,615
		24–12	...	..	(0.23 %)	.....	....	1–1000	6,012	6,012,000	1– 5	1-5	3477	18,080	....	......

* The upper figures in each space indicate number of cubic centimeters of normal alkali required to neutralize 1 liter of milk, as explained on p. 139; figures in parentheses indicate percentage of lactic acid, as ordinarily calculated.

TABLE II.—WORKING CONDITION AND RESULTS OF CONTINUOUS PASTEURIZATION OF MILK AT 80° C.

Date.	Age of milk.	Weight.	Initial temperature.	Acidity.*	Steam pressure on boiler.	Rate per hour.	Unpasteurized. Dilution.	Unpasteurized. Colonies on plate.	Unpasteurized. Germs per c.c.	Pasteurized. Dilution.	Pasteurized. Colonies on plate	Pasteurized. Germs per c.c.	Average germs per c.c. Unp.	Average germs per c.c. Past.
	Hours.	Lbs.	Deg C.		Lbs.	Lbs								
Sept. 27	12–4	206	13	....	.....	1122	1– 500	134	67,000	1–28	9	252	69,500	217
	....	...	..	....	.....	....	1– 250	288	72,000	1–14	13	182	....	...
28	12–4	168	12	....	.....	1680	1– 520	16	8,320	1–6 1-2	11	71	10,010	61
	....	...	..	....	.....	....	1– 260	45	11,700	1–4 1-3	12	52	....	...
Oct. 2	36–24	401	12	....	.....	1266	1– 366	141	51,606	1–6	5	30	42,573	25
	12–4	...	..	....	.....	....	1– 183 1-3	183	33,540	1–4	5	20	....	...
4	36–24	381	8	....	65–50	1632	1– 250	40	10,000	1–3 2-9	18	58	9,583	46
	12–4	...	..	....	.....	....	1– 416 2-3	22	9,166	1–2	17	34	....	...
6	36–24	382	10	....	35–33	1206	1– 157	126	19,782	1–2	10	20	18,191	21
	12–4	...	..	....	.....	....	1– 100	166	16,600	1–1	22	22	....	...
7	12–4	191	15	....	45–40	1636	1– 460	23	10,580	1–2	11	22	11,960	25
	....	...	..	....	.....	....	1– 460	29	13,340	1–1	28	28	....	...
9	36–24	364	12	....	40–30	1320	1– 300	121	36,300	1–2	20	40	38,100	36
	12–4	...	..	....	.....	....	1– 150	266	39,900	1–1	33	33	....	...
11	36–24	322	10	....	30–30	1248	1– 300	98	29,400	1–2	20	40	30,150	29
	12–4	...	..	....	.....	....	1– 150	206	30,900	1–1	18	18	....	...
13	36–24	326	13	....	60–65	1626	1– 300	41	12,300	1–2	13	26	15,750	20
	12–4	...	..	....	.....	....	1– 200	96	19,200	1–1	15	15	....	...
16	36–24	361	16	....	30–35	1272	1– 367	196	71,932	1–2	49	98	68,906	79
	12–4	...	..	....	.....	....	1– 183	360	65,880	1–1	61	61	....	...
18	36–24	323	17	....	45–55	1380	1– 400	82	32,800	1–2	31	62	47,300	51
	12–4	...	..	....	.....	....	1– 200	309	61,800	1–1	41	41	....	...
20	36–24	345	15	....	35–40	1146	1– 350	500	175,000	1–2	134	268	202,100	255
	12–4	...	..	....	.....	....	1– 150	1,528	229,200	1–1	243	243	....	...

	23	36–24	338	15	....	50–55	1194	1– 230	1,200	276,000	1–2	49	98	313,222	98
		12–4	...	..	....	.....	....	1– 383	915	350,445	1–1	97	97	....	...
Dec.	13	36–24	361	15	23.5	60–50	1272	1–1150	57	65,550	1–2	119	238	61,650	222
		12–4	...	..	(0.21 %)	.....	....	1– 350	165	57,750	1–1	207	207	....	...
	18	36–24	370	22	53	60–45	924	1– 400	41	16,400	1–3	62	186	19,000	210
		12–4	...	..	(0.298 %)	.....	....	1–1200	18	21,600	1–2	117	234	....	...
	20	36–24	331	26	20	50–65	1200	1– 150	100	15,000	1–3	69	207	15,000	190
		12–4	...	..	(0.18 %)	.....	....	......	......	....	1–2	87	174	....	...
	26	48–36	468	25	20	55–52	948	1– 432	58	25,056	1–2.8	102	285	26,352	255
		24–12–4	...	..	(0.18 %)	.....	....	1– 216	128	27,648	1–2	113	226	....	...
	28	36–24	376	21	18.5	60–20	900	1– 416	34	14,144	1–3	45	135	12,447	123
		12–4	...	..	(0.17 %)	.....	....	1– 250	43	10,750	1–2	56	112	....	...
Jan.	4	36	362	25	21	60–62	1890	1– 230	2,649	609,270	1–3	25	75	....	...
		24–12–4	...	..	(0.19 %)	.....	....	1– 383	1,462	559,946	1–6	7	42	584,608	58
	6	36–24	320	25	....	65–65	1920	1– 575	2,166	1,245,450	1–2	29	58	....	...
		12–4	...	..	....	.....	....	1–1150	3,169	3,644,350	1–3 1-4	28	91	2,444,900	74
	8	36–24	387	25	21	60–65	2108	1–2100	1,220	2,562,000	1–4	24	96	....	...
		12–4	...	..	(0.19 %)	.....	....	1– 700	3,330	2,331,000	1–2	55	110	2,446,500	103
	10	36–24	338	26	....	40–40	2136	1–2100	991	2,081,100	1–4	28	112	....	...
		12–4	...	..	....	.....	....	1– 700	2,652	1,856,400	1–2	40	80	1,968,750	96
	13	36–24	387	25	26.5	40–40	1716	1–2100	350	751,800	1–3	94	282	....	...
		12–4	...	..	(0.24 %)	.....	....	1–1050	733	769,650	1–2	156	312	760,725	297
	15	36–24	304	25	....	60–65	1824	1–2200	709	1,559,800	1–3	69	207	....	...
		12–4	...	..	....	.....	....	1–1100	1,285	1,413,500	1–2	79	158	1,486,650	182
	17	36–24	307	26	36	40–40	1602	1–2000	38,415	76,830,000	1–4	43	172	....	...
		12–4	...	..	(0.32 %)	.....	....	1–2000	38,677	77,354,000	1–2	45	90	77,092,000	131

* See foot note, Table I.

per cu. cm. found by Dr. H. L. Russell[6] in 50 samples of milk pasteurized by the discontinuous method for direct consumption, the surprising thoroughness of this continuous pasteurization at 80° C. will be understood.

Were it not for the fact that in the present state of our knowledge it is believed that a heating of milk to 85° C. (185° F.) in a continuous pasteurizer is necessary to remove all danger of tuberculosis, the use of 80° C. in pasteurization for butter-making, at least in this special machine, would leave little to be desired.

Confining our attention to the number of germs found in the pasteurized milk, the results of the above tests show that there is practically no increase in efficiency in passing from 80° C. to 85° C. If we can be allowed to generalize on so narrow a basis as seven determinations the gain comes in an increased regularity in the reduction of the number of germs present. There is also a practical advantage in working at a temperature well above that at which an active germ-killing effect begins.

The strongest argument in favor of 85° C. (185° F.) lies in the fact that it is the lowest one that we can use and feel assured that we have removed the danger of returning germs of tuberculosis along with the mixed skim milk from the factory. Leaving out of account all relation of this disease to the human family, its effect upon our calves and pigs is one that we cannot afford to ignore.

While it does not come within the province of this bulletin to discuss the effect of heating upon the butter, it will not be out of place to state that, even with cream from milk which had been heated to 85° C., butter was made in which no cooked flavor could be detected when coming from the churn. While our efforts were not universally so successful, still, in the cases where such a flavor was noticeable at churning, this disappeared after a few hours standing. The experience of this Station, so far as it goes, is quite in accord with that of Dr. Storch, who states that whole milk can be heated to 90° C. without any permanent injury to the flavor of the butter.

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[6] Ann. Rept. Wis. Agr. Exp. Sta., 1895, p. 159.

TABLE III.— WORKING CONDITION AND RESULTS OF CONTINUOUS PASTEURIZATION OF MILK AT 85° C.

Date.	Age of milk.	Weight.	Initial temperature.	Acidity.*	Steam pressure on boiler.	Rate per hour.	Unpas'eurized.			Pasteurized.			Average.	
							Dilution.	Colonies on plate.	Total germs per c. c.	Dilution.	Colonies on plate.	Total germs per c. c.	Unp.	Past.
	Hours	I bs.	Deg. C.		Lbs.	Lbs.								
Jan. 19	36–24	392	28	31	60–62	978	1–2200	23,422	51,528,400	1–3	16	48	....	...
	12	...	..	(0.28 %)	.....	....	1–1100	......	....	1–2	26	52	51,528,400	50
22	36–24	404	24	26	62–45	1860	1–2200	9,620	21,164,000	1–3	27	81	....	...
	12	...	..	(0.23 %)	.....	....	1–1100	24,830	27,313,000	1–2	42	84	24,238,500	83
24	36–24	362	34	27.5	60–60	1974	1–2100	11,284	23,696,400	1–4	16	64	....	...
	12	...	..	(0.24 %)	.....	....	1–2100	7,020	14,742,000	1–2	26	52	19,219,200	58
26	36–24	370	26	....	55–35	1584	1–4400	4,264	18,761,600	1–4	61	244	....	...
	12	...	..	....	.....	....	1–2200	7,410	16,302,000	1–2	112	224	17,531,800	234
29	36–24	361	25	27.5	60–60	1694	1–4200	2,671	11,218,200	1–3	32	96	....	...
	12	...	..	(0.24 %)	.....	....	1–2100	10,135	21,283,500	1–2	35	70	16,250,850	83
31	36–24	353	30	27.5	65–60	1410	1–4200	118	495,600	1–4	50	200	....	...
	12	...	..	(0.24 %)	.....	....	1–2100	262	550,200	1–2	106	212	522,900	206
Feb. 7	36–24	350	25	35.5	65–65	1314	1–4800	11,830	56,784,000	1–4 1-4	18	76	....	...
	12	...	..	(0.319%)	.....	....	1–2400	17,310	41,544,000	1–2	44	88	49,164,000	82

* See foot-note, Table I.

REPORT

OF THE

Department of Botany.

F. C. STEWART, *Botanist.*
F. H. BLODGETT, *Assistant Botanist and Entomologist.*
F. M. ROLFS, *Student Assistant.*

TABLE OF CONTENTS.

REPORT OF THE BOTANIST.

LEAF SCORCH OF THE SUGAR BEET, CHERRY, CAULIFLOWER AND MAPLE.*

F. C. STEWART.

SUMMARY.

In central New York the foliage of sugar beets, cherries, Norway maples and sugar maples has been scorched by excessive transpiration. On Long Island cauliflower has been similarly affected. Plants standing in dry, sandy soil have suffered most.

With the sugar beet, the leaves blacken and die. In severe cases the plant is killed outright, but generally the affected plants revive and make a second growth. The affected roots are small, frequently discolored, and poor in sugar.

With the cherry, part of the foliage, often as much as three-fourths, becomes brown and dead. The variety Montmorency Ordinaire is the one most commonly affected. This trouble has been common in the vicinity of Geneva the present season and is said to have occurred in one orchard quite severely in 1898, without, however, affecting the crop of 1899.

With the cauliflower, the tips of young leaves turn brown, as if frosted. This occurred quite commonly in eastern Long Island during August, but did little damage.

The foliage of Norway and sugar maples is much subject to injury from excessive transpiration. The leaves become light brown or reddish brown. Nursery trees and those recently transplanted suffer most, but large shade trees are not exempt. Little permanent injury is done except to newly-set trees.

* Reprint of Bulletin No. 162.

With all of these plants the trouble is not due to a gradual drying, but to a sudden scorching by the transpiration of more water from the leaves than the roots are able to supply.

INTRODUCTION.

It is not an uncommon thing for the foliage of various plants to be injured by excessive transpiration. Such injury may be brought about in either of two ways: (1) By a process of gradual drying, such as occurs in plants suffering from drought, and (2) By sudden scorching, as when a fire is built under a tree. With the first kind of injury every one is familiar and those living in the arid and semi-arid portions of our country have frequently observed the latter kind. In Kansas, for example, dry, hot southwest winds often ruin promising crops of corn in two or three days.

But here in the East, the sudden scorching of foliage by hot wind and sun is of such rare occurrence that it attracts attention and is generally misunderstood by farmers and fruit growers. It is frequently mistaken for infectious disease. The object of this bulletin is to place upon record some observations on the sudden scorching of the foliage of sugar beet, cherry, cauliflower and maple, due to excessive transpiration.

LEAF SCORCH OF SUGAR BEET.[1]

About the middle of August, 1899, some farmers in Yates and Ontario counties wrote to the Station that their sugar beets were blighting. On August 29, the writer visited several of the affected fields and found the so-called blight to be characterized as follows: On slightly affected plants the only indication of disease was to be seen in the brown or black, dead leaf margins. In more severe cases the young leaves at the center of the crown were black and dead, as were also the blades of most of the leaves. Many plants showed nothing green but the petioles of the larger

[1] For the illustrations used in this bulletin, the author is indebted to Mr. F. H. Blodgett, Assistant Botanist and Entomologist.

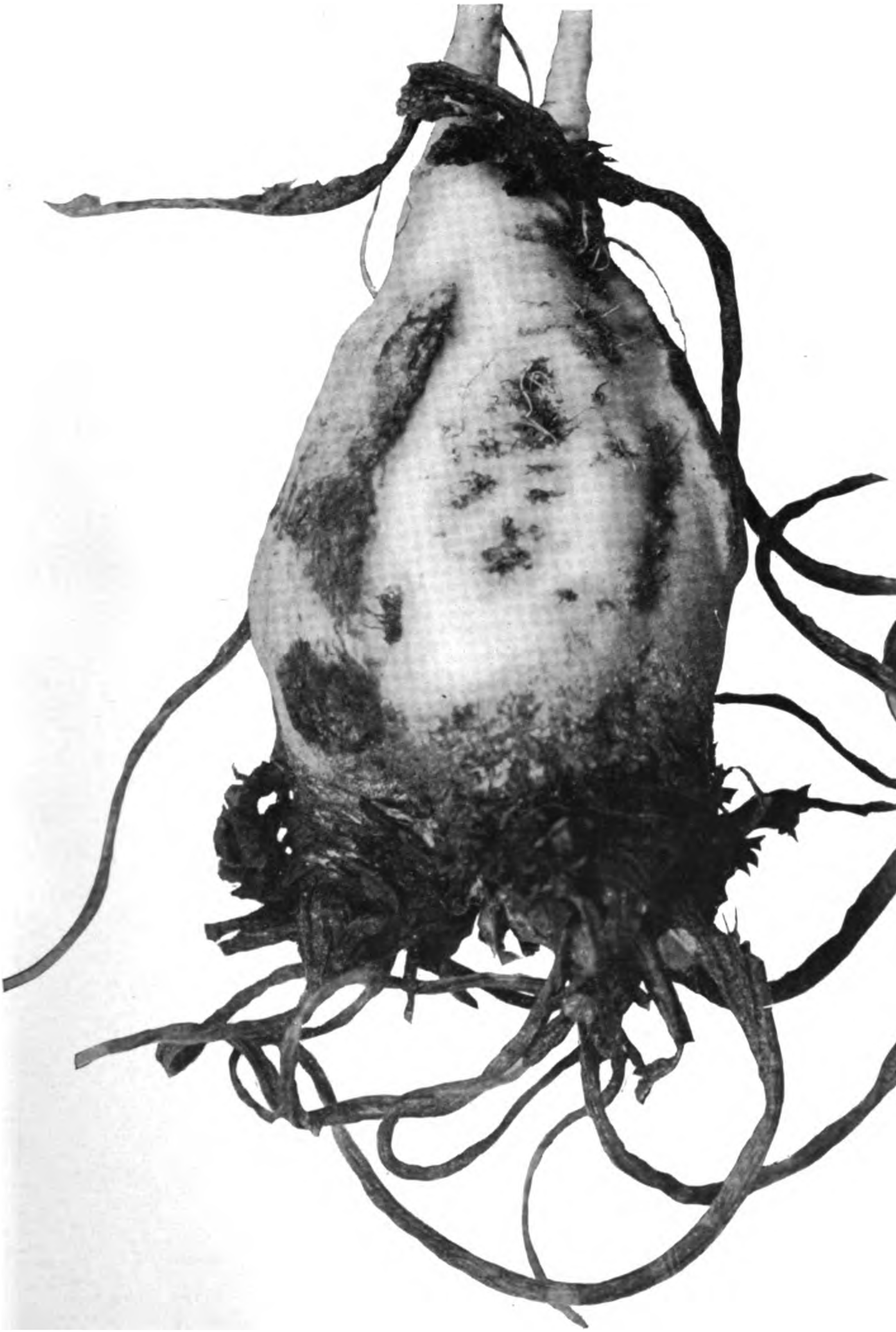


Plate IV.—Sugar Beet Killed by Leaf Scorch. Early stage.

Plate V.—Sugar Beet Killed by Leaf Scorch. Middle Stage.

leaves. In the petioles of the dead leaves the fibro-vascular bundles were not blackened except, perhaps, for a short distance below the blackened blade. In the majority of cases the roots appeared normal, but the plants most severely attacked often showed a brown discoloration of the root. This discoloration extended from the outside toward the center for a distance of from one-fourth to one-half an inch. The discolored tissue showed no indication of rot and was separated from the healthy tissue by an indefinite and somewhat irregular line. (See Plate VIII.) The fibro-vascular bundles colored somewhat more deeply than the parenchyma, giving a zonate appearance to the affected tissue. The location of the affected tissue could generally be determined before the root was cut open, by the darker color and pronounced elevation of the bark. (See Plates IV and V.) In some cases when an affected root was cut cross-wise just below the crown the fibro-vascular bundles were found to be much blackened, but this character was by no means a constant one.

For a time the writer was puzzled to account for this condition of the beets. The first hint of the true nature of the trouble was obtained from observations made on a field of beets owned by Mr. Clark Crozier, near Halls. This field was level and the soil a sandy loam, with the exception of a small knoll which rose abruptly near the center of the field and consisted of very light, sandy soil. The beets on this sandy knoll were diseased, while those on all the rest of the field were in perfect health. This indicated that lack of water was the cause of the trouble. A severe drought was prevailing at the time and naturally the plants first affected would be those standing in dry, sandy soil. Further observations showed that the beet blight occurred chiefly upon light, sandy soil; but a field near Stanley furnished an exception to the rule. This field, which contained about eight acres, consisted principally of sandy loam, which might be expected to resist drought better than many other fields in the vicinity. As a matter of fact, it was considerably blighted, not uniformly, but over irregular areas, although

the soil appeared to be absolutely uniform. However, it should be stated that the blight was most severe along one margin of the field where the ground began to rise a little. The owner of this field stated that early in the season there came heavy rains, which prevented cultivation for a few days. In the meantime the plants became so large that it was decided not to cultivate them any more. The drought then began. The soil became hard and cracked and consequently parted with its moisture more rapidly that it would if it had been cultivated after the rains as were other fields in the neighborhood. The loss of water was still further accelerated by the unusually luxuriant growth of leaves, which was the result of a high state of fertility of the soil.

At the time of our first visit to this field, August 29, it was observed that many of the affected plants had thrown out new leaves at the center of the crown. We thought this to be the result of a light shower[2] which fell August 27, and predicted that growth would very soon be checked unless more rain fell. We were accordingly surprised to find upon our second visit, September 12, that the blight had made no progress. On the contrary, most of the affected plants were putting out young leaves at the crown. (See Plate VII.) On many plants an entirely new crops of foliage had appeared during the previous two weeks. Plants which were apparently dead two weeks before were now green with a crown of new leaves; and this in spite of the fact that there had been no rain worth mentioning[3] since our former visit. All other affected fields showed similar improvement. A few of the worst affected plants were dead, but the majority were making a second growth. It now became evident that this beet blight was not a gradual drying of the foliage

[2] At Penn Yan, .36 inch; at Geneva, .26 inch.

[3] The actual precipitation was as follows:

At Penn Yan. Sept. 1, 1.07 in.; Sept. 3, trace; Sept. 5, trace; Sept. 8, .23 in.; Sept. 11, .09 in.

At Geneva. Sept. 1, .10 in.; Sept. 2, trace; Sept. 5, trace; Sept. 8, .07 in.; Sept. 11, .04 in.

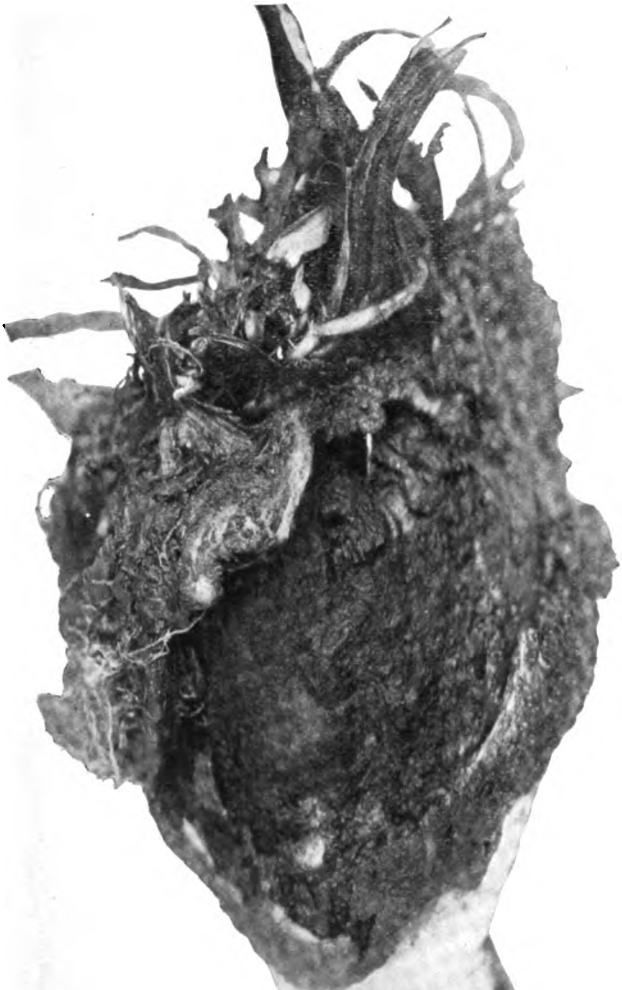


PLATE VI.—SUGAR BEET KILLED BY LEAF SCORCH. ADVANCED STAGE.

PLATE VII — SECOND GROWTH OF SUGAR BEET FOLIAGE.

due to a gradual decrease in the supply of water in the soil, but that it had been brought about suddenly. Some time during the first two weeks in August, probably about August 9, the weather conditions (temperature, humidity and wind) had been such that the quantity of water transpired by the leaves was greater than the roots were able to supply. As a result the leaves were scorched. Then, with the passing of the conditions which induced excessive transpiration, the roots were again able to meet the demands for moisture thereby enabling the plants to resume growth, although the soil was drier than at the time the injury occurred.

It has already been stated that some of the plants were killed outright. Upon a third visit to the affected field at Stanley, made October 24, it was observed that these dead roots were still sound except for brown, mostly V-shaped, scab-like areas upon the upper portion of the root. These brown areas represent the later stage of the raised, discolored areas observed on August 29. The tissue was decayed to a depth of from one-eighth to one-quarter of an inch and had been quite generally eaten away by millipedes, leaving cavities where in the earlier stage of the disease there had been elevations. (See Plate VI.) Underneath the affected areas the sound tissue showed the same light brown discoloration as on August 29. It seemed to have progressed, but little, if any. Sometimes the browning occurred in the central portion of the root, but usually it was found only around the circumference and almost always in the form of concentric rings. In the field at Stanley the dead roots quite generally showed the light brown discoloration of sound tissue, but in an affected field at Bellona it was a common thing to find bad cases of the disease in which there was little or no internal browning.

The plants which survived made a considerable growth of new foliage. The roots of such plants did not commonly show any discoloration or decay, but, strange to say, they averaged considerably smaller than the roots of plants which had been killed outright. This indicates that the plants which were the largest

and thriftiest at the time of the injury were the ones most severely affected; and, further, that during two months of second growth the surviving plants increased the size of their roots but little.

That the discoloration of the root is a physiological effect (the result of the death of the foliage) rather than the work of any parasitic organism is shown by the results of the following inoculation experiment: After the dirt around five healthy sugar beets had been removed there was cut from each a pyramidal cavity one-fourth inch square at the surface and one-half inch deep. These cavities were then filled with similarly shaped plugs of the discolored beet root, the whole covered with grafting wax and the dirt replaced. Five check beets were treated in the same manner except that the cavities were filled with plugs of healthy beet. This was done August 30. On October 18 the beets were pulled and cut open. The inoculated beets showed no discoloration of tissue except a slight blackening around the wounds, which was no greater than in the check roots.

Some farmers thought that the beet disease was much worse on land where cabbages were affected by black rot in the season of 1898, but our own observations show that there is not good foundation for such belief. It can be stated positively that there is no connection between the leaf scorch of beets and the black rot of cabbage.

The amount of damage done to the beets was considerable. Although the majority of the plants recovered, the roots were smaller than they otherwise would have been and their sugar content was lower. Analyses made by Mr. J. A. LeClerc, Assistant Chemist, gave the following results: (1) Roots of plants killed outright analyzed 5.9 per ct. of sugar (in the juice) with a coefficient of purity of 61.6; (2) Roots of plants which had made a second growth after having all their foliage killed analyzed 10.7 per ct. of sugar, coefficient of purity, 73.6; (3) Roots of uninjured plants growing within a few feet of the diseased plants analyzed 15.2 per ct. of sugar, coefficient of purity, 80.3.

The only other beet leaf disease with which leaf scorch is likely to be confused is a fungus disease known as leaf spot.[4] This is a common and destructive disease of beets in New York State and is more prevalent in wet seasons than in dry. It forms circular, brown or gray dead spots on the leaves. If the spots are numerous a part or the whole of the leaf may die and turn black in a manner closely resembling leaf scorch, but in such cases the outlines of the spots are plainly visible until the leaf is fully decayed.

In the advanced stage, the effects of leaf scorch on the beet root might easily be mistaken for scab. In general, it may be distinguished from scab by the light brown discoloration of the sound tissue but when the brown discoloration is absent the diagnosis must be based chiefly upon the shape and location of the affected areas. In leaf scorch the affected areas occur principally upon the upper portion of the root and are usually more or less V-shaped with the opening toward the crown; whereas, in scab the spots occur on any part of the root and are more often irregular or circular than V-shaped.

Concerning treatment it is needless to say that proper irrigation is a sure preventive; but where irrigation can not be practiced avoid planting on light, sandy soil and in dry weather conserve the moisture by stirring the soil frequently and especially after every shower.

LEAF SCORCH OF CHERRY.

Late in September of the present year a Geneva fruit grower called our attention to a scorching of cherry foliage which he feared might be an infectious disease like the fire blight of the pear and apple. On trees of all ages more or less of the foliage was brown, crisp and dead. The dead leaves remained attached to the twigs which were neither blackened nor shriveled. A

[4] For an account of beet leaf spot and scab and their treatment, see Cornell Exp. Sta. Bul. 163. Three Important Diseases of the Sugar Beet.

brief study of this disease convinced us that we had here to do with a trouble similar to the leaf scorch of beets. Like the beet disease it was most severe on trees standing in dry soil. Upon inquiry among fruit growers it was found to be of common occurrence this year.

The worst case of the disease which has come under our observation occurred in an orchard belonging to Maxwell Bros. near Geneva. This orchard contained 715 Montmorency cherry trees about eleven years of age, the trunks having a diameter of from four to five inches. The trees were set fifteen feet apart each way. Over the whole orchard the soil was uniform and had been thoroughly cultivated. It consisted of a light clay underlaid with slate at a depth of from eighteen inches to two feet. The orchard was located on a gentle eastern slope and was closely surrounded upon all sides by other fruit trees.

On October 4 each tree in the orchard was examined and an estimate made of the amount of foliage affected. The result was as follows:

1	tree, 100 per cent. of the foliage affected.
637	trees, 75 to 85 per cent. of the foliage affected.
57	trees, 50 per cent. of the foliage affected.
13	trees, 25 per cent. of the foliage affected.
5	trees, 5 per cent. of the foliage affected.
2	trees, not affected.
715	

It is an interesting fact that although six-sevenths of all the trees in the orchard showed 75 per ct. or more of the foliage affected there was but a single tree upon which all of the foliage was killed. The trees were affected with remarkable uniformity. The worst affected trees stood in no particular part of the orchard but were scattered all through it. Although it frequently happened that one side of a tree would be severely attacked while the other half was entirely exempt, there was no uniformity as to the side attacked; it was quite as often the north side as any

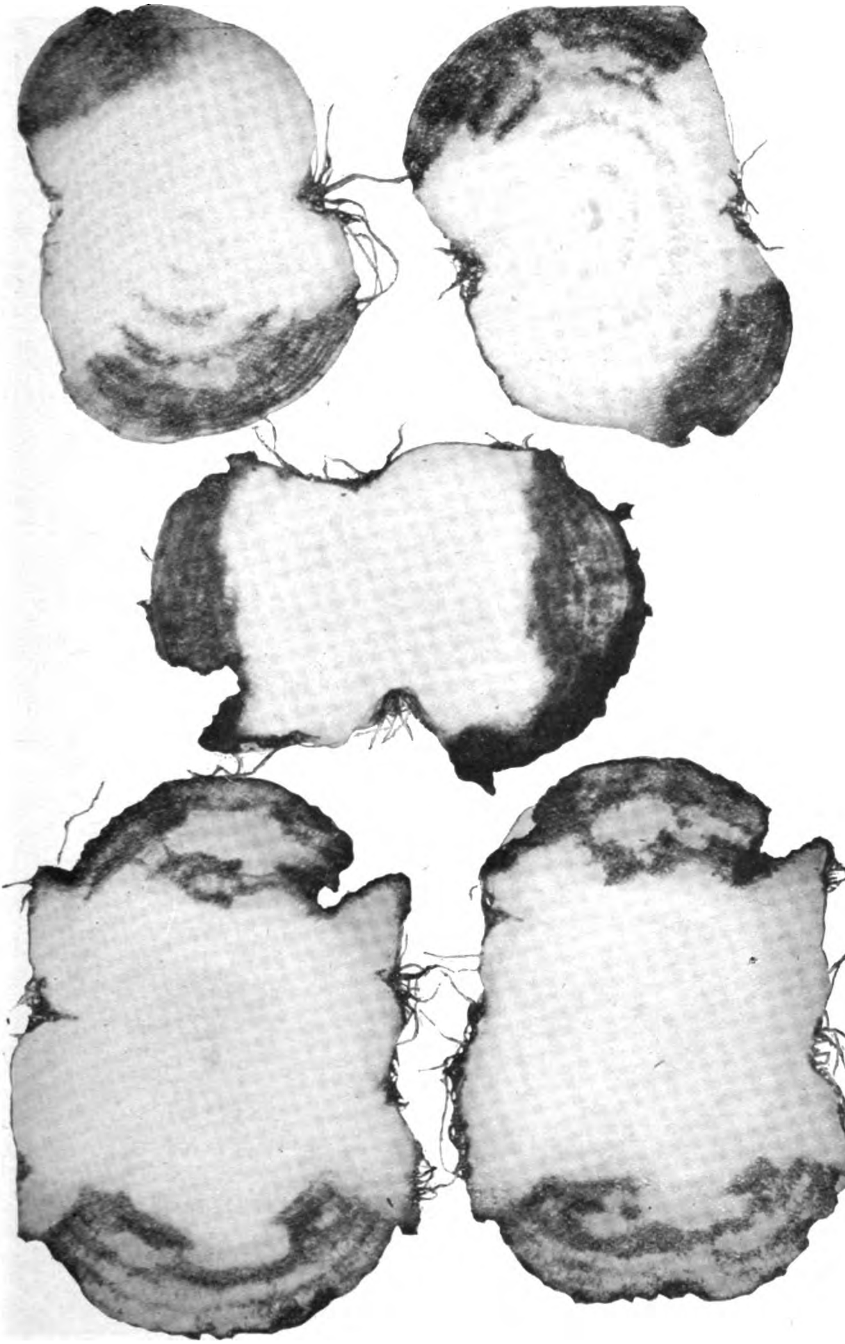
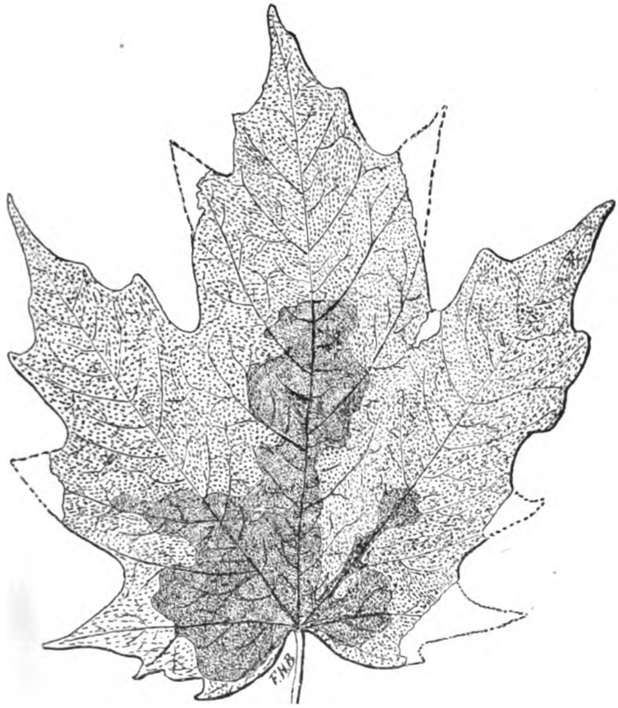
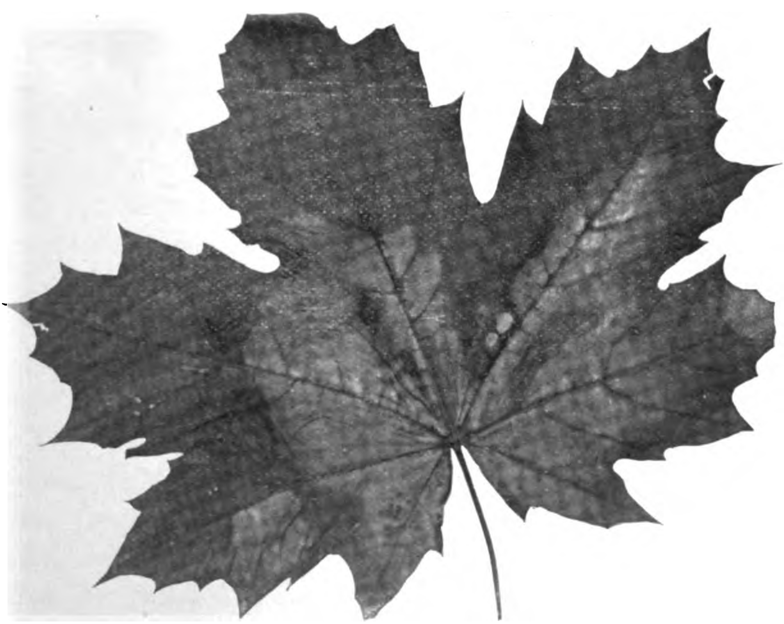


PLATE VIII.—CROSS SECTIONS OF SUGAR BEETS KILLED BY LEAF SCORCH.



A. LEAF OF SUGAR MAPLE. LIVING PORTION AT CENTER.



B. LEAF OF NORWAY MAPLE. DEAD PORTION AT CENTER.

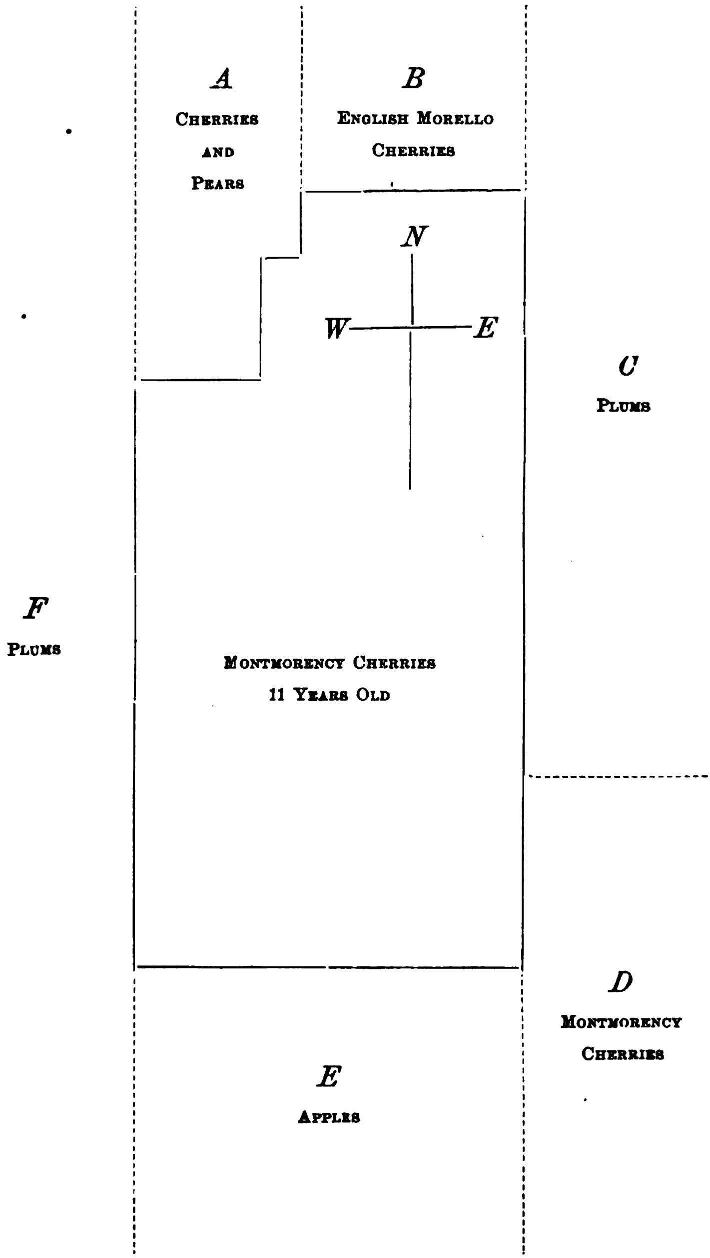
PLATE IX.—MAPLE LEAVES INJURED BY LEAF SCORCH.

other. Usually, the affected branches were scattered all through the top. Lateral branches were more apt to be affected than main or leading branches, but there were some exceptions even to this rule. If any part of a leaf was affected the whole of it was affected, with very few exceptions. The majority of the affected leaves were still hanging upon the twigs on October 4, but they showed a tendency to fall somewhat earlier than the healthy leaves. The twigs were plump and outwardly normal. The cortex was green and apparently normal, but the sapwood was slightly discolored. This discoloration was most pronounced on twigs of the present season's growth, but was noticeable all along the branch.

The foreman in charge of the orchard states that the disease appeared rather suddenly, although not quite all at once and that it occurred about August 20. The orchard was affected in a similar manner in 1898, but not so severely. In 1898 the scorching appeared in July before picking was all done and it was feared that the following crop would be considerably lighter because of it. However, such was not the case. The crop of 1899 was a heavy one and there were no visible effects of the scorching of the foliage the previous summer. This orchard was also slightly affected in 1897.

It appears that cherries are much more liable to this sort of injury than are pears, plums or apples. Scattered through the affected cherry orchard there were a few small pear trees which had been planted to replace dead cherry trees. None of these pears showed any sign of leaf scorch; neither did the pears located at A (see Plan) on the same kind of soil. Plum trees at C and F immediately adjoining the diseased cherries were in perfect health. The several different varieties of apples at E were also unaffected. The English Morello cherries at B were considerably affected but not so severely as the Montmorencies. The Montmorency orchard at D was composed of young trees and situated upon moister and deeper soil. However, a good

many trees were slightly affected, especially those standing in the corner of the orchard near the old Montmorency orchard.



Plan of Maxwell's Cherry Orchard affected with Leaf Scorch.

In no other orchard examined have the trees been so uniformly affected as in this one; perhaps because in no other case have the soil and conditions been so uniform. In general, trees affected in varying degrees up to one-half of the foliage have been found freely intermingled with perfectly healthy trees; but when an orchard was situated partly on dry and partly on moister soil, the disease was invariably worst on the trees standing in the dry soil.

In one orchard of large trees of Montmorency the disease was confined chiefly to the lower branches. A cherry grower at Hector states that in his orchard the trees were generally affected upon the south side, but in the orchards about Geneva we have not observed that the south side of the tree is more often affected than any other side. Trees standing in exposed situations have been no more affected than sheltered trees.

As to the time the injury occurred there is a difference of opinion among fruit growers. Some believe that the injury came on gradually, but the majority are of the opinion that it occurred within a comparatively short space of time. Some say it occurred early in August, others about the middle of August and one is certain that his orchard was not affected until the first week in September. It is not improbable that there were two periods when the weather conditions were favorable to the scorching of foliage. One occurred some time during the first half of August and the other on Sunday, September 3. On the latter date the temperature was high, the air dry and a strong wind blowing. The writer expected much injury to result from this, but observed none whatever. Nevertheless, cherries in some situations may have been injured.

Some have attributed leaf scorch to over-bearing, but there is no evidence to support this theory. In many cases trees which have never borne fruit have been severely affected. It is possible that fruit-bearing tends to increase the liability to the disease, but even that remains to be proven.

Accurate information is lacking as to the susceptibility of different varieties. Montmorency[5] has been more commonly affected than any other variety, but English Morello and some other varieties have shown it to a considerable extent.

From the experience of Maxwell Bros., it would appear that little harm is likely to result from this scorching of the foliage, but it seems incredible that a cherry tree can lose a large part of its foliage in July or August without affecting its productiveness. The effect must be the same as if the leaves were removed at this time. We shall watch the Maxwell orchard with interest the coming season.

LEAF SCORCH, OR TIP BURN, OF CAULIFLOWER.

On September 1 Mr. F. A. Sirrine, Entomologist at our Branch Office on Long Island, sent to the Station some cauliflower leaves the margins of which were blackened and shriveled. The diseased leaves were accompanied by a letter saying that throughout eastern Long Island the partly unfolded leaves of cauliflower were quite generally affected in this manner. On September 7, in company with Mr. Sirrine, the writer visited some of the affected cauliflower fields in the vicinity of Mattituck. At this time the affected leaves were growing and appeared normal except for their crisp, brown or black margins. The newest leaves were entirely free from the trouble showing that the cause of the blackening was not then active. It was quite plainly another case of leaf scorch.

Large plants were more severely injured than small ones. The worst affected field observed was one in which the plants were very large and thrifty and had commenced to form heads.[6]

As with the beet and cherry, the exact time the injury occurred is unknown. It occurred some time during the last ten days of August. Although the rainfall for August in this section was

[5] The Montmorency grown at Geneva is Montmorency Ordinaire.

[6] Cauliflower was not generally heading at this date, September 7.

very light (.75 inch at Cutchogue) there was considerable fog. Mr. Sirrine states that there was continuous fog from August 18 to 20, inclusive, and some each day for a week following this period, but no rain fell between August 13 and 31. It is our opinion that the injury was caused by the hot sun falling upon young leaves which were unusually tender because of having grown in foggy weather.

Tip burn should not be confused with the bacterial disease called black rot[7] of cauliflower, cabbage and related plants. Both diseases may occur in the same plant, but many plants affected with tip burn show no blackening of the fibro-vascular bundles — the most reliable diagnostic character of the black rot. Tip burn affects the margins of the young leaves, while black rot attacks chiefly the old leaves and when it does occur on young leaves shows itself throughout the whole leaf rather than at the margin.

The amount of damage done by tip burn of cauliflower has been small.

LEAF SCORCH OF NORWAY AND SUGAR MAPLES.

The Norway maple, *Acer platanoides,* is much subject to injury from excessive transpiration. In New York more or less of it occurs nearly every season. It is most common on recently transplanted trees, but very frequently occurs on rapidly growing nursery stock and in very dry seasons may be observed also upon large shade trees. During the past season this maple leaf scorch has been been unusually common. Besides attacking the Norway maple it has been common on the sugar maple, *Acer saccharinum.* In the course of a half day's drive in Central New York during last August or September one might see along the roadside, perhaps, a hundred or more sugar and Norway maples on which more than half of the foliage was brown Many slightly affected trees would also be seen.

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[7] ***Pseudomonas campestris*** **(Pammel) Smith.**

If the injury is severe and occurs before the leaves are fully grown,[8] the injured leaves fall and new ones appear, but if the injury occurs after the leaves are full grown they remain attached to the twigs until late in autumn. In the latter case some of the leaves will be found wholly dead, but the majority of them will show a dead, brown portion and a living, green portion. As a rule, especially on the sugar maple, the dead portion is located around the margin of the leaf (see Plate IX, fig. A), but it may occur in the form of circular or irregular blotches; or the margin of the leaf may be occupied by living, green tissue surrounding a dead area at the center (see Plate IX, fig. B). In all cases the living tissue is separated from the dead by a sharply defined line. The color of the dead tissue is either light brown or reddish brown. The injured leaves for the most part remain expanded.

As with the beet, cherry and cauliflower, this injury to maple foliage occurs in a comparatively short space of time. It happens whenever the quantity of water transpired by the leaves is greater than that which the roots are able to supply; and this condition of things may be brought about in several ways. Some of the factors which enter into the problem are: Area of leaf surface exposed, quantity of water in the soil, activity of the roots, and location of the tree as regards exposure to wind. Having in mind these several factors, it is easy to understand how one tree may be seriously injured while another tree standing close beside it may not be affected at all. This is of common occurrence.

In nurseries the disease often escapes notice until the dead leaves have become overgrown with various saprophytic fungi which are likely to be mistaken for the cause of the trouble.

Trees recently transplanted may die from the effects of leaf scorch, but established trees rarely show any permanent injury.

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8 Observations upon the scorching of immature maple foliage have been reported by Stone, G. E., and Smith, R. E. Wilt of Maple Leaves. Ninth Ann. Rept. Hatch Exp. Sta., of Mass. Agr. Coll.: 81–82; also by Stewart, F. C. Norway Maples Injured by Dry Winds. Fifteenth Ann. Rept. of this Station: 453–454.

There is a fungous disease of the Norway maple which might be mistaken for leaf scorch by one unfamiliar with the latter trouble. This is an anthracnose[9], *Gloeosporium apocryptum* E. & E., which attacks the leaves and young shoots. It is most severe on small trees, especially nursery trees, occurring but rarely on large shade trees. It attacks chiefly the terminal shoots, often transforming them into much branched "heads." The leaves are dwarfed and have a yellowish green color, with the margins curled downward and blackened as if slightly frosted. This disease is prevalent in Long Island nurseries and has been observed at Geneva the present season on nursery trees and small shade trees.

[9] See Fourteenth Ann. Rept. N. Y. Exp. Sta., 1895: 531–532.

NOTES ON VARIOUS PLANT DISEASES.*

F. C. STEWART.

SUMMARY.

I. During the season of 1898 a bacterial rot caused heavy losses to the onion growers in Orange Co., N. Y. The onions were found to be affected at harvest time. One or more layers of the onion would be soft rotten while the adjacent layers were sound. Sometimes the rotten layers were on the interior, in which case the affected bulbs might be difficult of detection; or the rot might be confined to the outermost fleshy layer, producing the so-called slippery onions. Although this rot is quite certainly due to bacteria, it is not readily produced by inoculation with diseased tissue except in the presence of water. This shows that water is an important factor in the rot and that the unusually large amount of rot in 1898 was due to the excessively wet weather which occurred in July and August of that year. Thorough drainage and clean cultivation are recommended as preventive measures.

II. Leaves of field cucumbers affected with a powdery mildew have been received from Athens, Pa. This is believed to be the first record of the occurrence of powdery mildew on field-grown cucumbers in America. In greenhouses it is not uncommon. The identity of the fungus is uncertain, but it is probably different from the powdery mildew occurring on squashes and pumpkins.

III. A dodder, *Cuscuta gronovii* Willd., has occurred on greenhouse cucumbers at the Station. Plants affected with this parasite should be immediately destroyed to prevent it from spreading. It is very aggressive.

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* Reprint of Bulletin No. 164.

IV. The disease of Baldwin applies, known in New York as the Baldwin fruit-spot, is characterized by small brown sunken spots which occur on the fruit about the time it is gathered. Underneath the spots the tissue is light brown and spongy. The diseased tissue contains no fungus hyphæ. In moist chamber the spots do not enlarge and no fungus appears on them. On various culture media the affected tissue produces no growth. The conclusion is that the disease is not caused by fungi or bacteria. However, the work of other investigators indicates that similar spots on the Baldwin and other varieties may be due to parasitic organisms and hence the desirability of greater care in the writing of descriptions.

V. A species of *Fusarium* has been found producing a serious leaf spot disease of carnations at Syracuse. It occurred upon plants so situated that the direct sunlight could not reach them. The fungus gains entrance through breaks in the epidermis made by rust sori. It is not improbable that it may be identical with the carnation stem-rot *Fusarium.*

VI. *Chaetomium contortum* Pk., a rare fungus hitherto found only on lily bulbs on Long Island, has occurred at Geneva under circumstances which aroused the suspicion that it is parasitic on barley seedlings; but an inoculation experiment showed that it is not parastic.

I. A BACTERIAL ROT OF ONIONS.[1]

In the autumn of 1898 the report came to the Experiment Station that the onions in Orange Co., N. Y., were rotting badly. Upon investigation it was found that in nearly all of the fields in this great onion growing district there was a considerable amount of rot. In many cases from one-third to one-half of the crop had to be rejected on account of it, and the remainder was not readily salable because news of the rot had reached New York city pro-

[1] This paper was read at the Columbus meeting of the Society for the Promotion of Agricultural Science, August 22, 1899, and will subsequently be published in the Proceedings of that Society.

duce dealers who were accordingly suspicious of all onions coming from Orange Co. The same rot was also common in the onion fields of Madison Co., but the losses from it there were not nearly so great as in Orange Co.

The rot was of two kinds: (1) One which starts at the bottom of the onion, and (2) One which starts at the top or "neck." The latter kind of rot was much the more common, constituting perhaps eighty per ct. of the total amount of rot. Where the rot had started at the top the bulbs were frequently sound in appearance, but rotten within. Oftentimes it was difficult to determine, before cutting, whether or not a bulb was rotten. In sorting, the customary test for soundness was to press down with the thumbs close about the "neck" of the onion. If it was hard the bulb was sound, but if soft it was usually rotten inside. Onion growers speak of such onions as being "weak in the neck." Upon cutting open the affected bulbs it was generally found that two or three of the outer scales were perfectly sound while the remainder of the bulb was a rotten mass. Frequently a single scale would be entirely rotten from top to bottom and clear around the bulb, while the remaining scales upon both sides of it, were perfectly sound. Such specimens cut crosswise showed the rotten part in the form of a ring. (See Plate X.) Again, a perfectly sound scale would be found between two rotten ones. (See Plate XI.) The rot appears never to spread from one scale to another laterally, and this peculiarity furnishes the most reliable means for the identification of this rot. The organism causing it is unable to pass through the uninjured epidermis of the scale. The passage from one fleshy layer to another is effected at the base of the bulb where they unite. Upon reaching the base of the scale in which it is working the rot commonly stops, and this accounts for the large number of cases in which one or two scales are rotten while the remainder of the bulb continues sound. Under certain conditions the rot does not stop at the base, but works its way into the bases of other scales which it then follows upward destroying the whole bulb.

PLATE X.—ONIONS AFFECTED WITH BACTERIAL ROT.

PLATE XI.—SOUND SCALES OF ONION BULB BETWEEN ROTTEN SCALES.

When the rot is confined to the outermost fleshy scale, as is frequently the case, the affected bulbs are called "slippery onions." Some of these are to be found in any season, but they are rarely so abundant as to cause material loss.

Microscopic examination of the rotten tissue shows entire absence of fungi, but there are swarms of a medium-sized motile bacillus which is without doubt the immediate cause of the rot.

When the rot commences at the bottom of the bulb the whole lower part is soft and eventually the entire onion becomes involved. The rot spreads upward through all of the scales simultaneously. Bulbs so affected show a profuse growth of *Fusarium* about the base and the rotten tissue is filled with the *Fusarium* hyphæ mingled with the previously mentioned bacillus. Although the presence of the bacillus is sufficient to account for this base rot it seems probable that the *Fusarium* aids materially and in some cases it may be the primary cause.

By inquiry among onion growers it was learned that there is in nearly every season a small amount of loss from rot which usually appears in the form of "slippery onions," although both the center rot and the base rot have long have been known. The noteworthy fact in connection with the rot in 1898 is the unusually large amount of center rot.

The rot was noticed by farmers when the crop was harvested in August, but the full extent of the trouble was not realized until a month later when the crop was sorted for market. At first it was attributed to injury from hail which fell on July 30; but later the hail theory was rendered untenable by the discovery that there was considerable rot in fields which had not been struck by the hail. Probably, the wind accompanying the hailstorm was a much more important factor in the rot. In nearly all of the onion fields the tops were much broken by the wind.

Among stored onions kept reasonably dry the rot progresses very slowly, but wet onions rot rapidly, especially if the temperature is high.

All of the evidence obtainable goes to show that this bacterial rot is not new, but that it is an old enemy which found unusually favorable conditions for its development in some peculiarity of the weather during the season of 1898. As yet, no attempt has been made to determine the identity of the organism causing it. It may be the same as the one causing the rot of onions and other plants observed by Halsted[2] in New Jersey.

The weather records published by the New York State Weather Bureau show that the rainfall in Orange Co. was excessive and the temperature high from the middle of July to the close of August, 1898. At Middletown, which is on the edge of the onion district, the dates upon which rain fell[3] during this period were as follows:

RAINFALL AT MIDDLETOWN, N. Y., JULY 18 TO AUGUST 26, 1898.

Date.	Inches.	Date.	Inches.
July 18	.31	August 11	.80
July 19	.51	August 12	.08
July 20	.90	August 16	.28
July 21	1.85	August 17	1.31
July 26	1.04	August 19	.41
July 28	.09	August 23	3.08
July 30	1.09	August 24	.42
August 1	1.48	August 26	.52
August 4	1.15		
Total			15.42

In forty days 15.42 inches of rain fell and it was so evenly distributed over the period that the ground was almost constantly wet. The onion fields, being on a low level, were frequently inundated. In some cases whole fields were covered by the water for a period of from 12 to 36 hours. It is not strange that the onions rotted.

The important role which water plays in this rot is shown by the behavior of laboratory cultures. Sound onions were cut open,

[2] Halsted, B. D. The Root Rot of Salsify. Gard. and Forest. 3: 576. N. 1890: Also, Eleventh Ann. Rept. N. J. State Ag. Exp. Sta., 1890: 352.

[3] Rept. N. Y. State Weather Bureau, vol. X, No. 7, p. 11, and No. 8, p. 11.

placed in a moist chamber and inoculated upon the cut surface with bits of rotten onion. At the end of a week there was only a trace of rot at the points of inoculation. Similar inoculations with pure cultures of the *Fusarium* likewise gave negative results. Sound onions, in moist chamber, were bored to the center with an awl and bits of rotten onion introduced into the wounds. At the end of a week there were no signs of rot. This experiment was repeated several times and always with the same result — the onions refused to rot. During these experiments the temperature of the room varied from 21° to 26° C. (70° to 79° Fahr.).

Finally, sound onions inoculated externally with bits of rotten tissue were immersed in sterilized water and placed in an incubator kept at a temperature of 36° C. (97° Fahr.). Other sound onions were treated in the same way, except that they were not inoculated. Still others were inoculated by boring to the center and introducing rotten tissue. These latter were then put into the incubator with the others, but not immersed in water. At the end of six days all of the onions immersed in water were rotten, including checks; while those which had been inoculated, but kept dry, were still perfectly sound.

These experiments indicate that one important point in the prevention of this rot is to keep the onions dry. In practice this is to be accomplished by protecting stored onions from rain and by draining the fields so that water will not stand upon them for any length of time.[4]

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[4] Since the above was written, some observations have been made upon the crop of 1899. The season of 1899 was unusually dry in Orange county, and yet there were a good many "slippery" onions in some fields. In looking over the onion fields, it was observed that some were almost entirely free from weeds, while others were thickly overgrown with them. It was in the latter kind of fields that the "slippery" onions occurred. The explanation of this appears to be that the weeds kept the onions wet by retaining the dew and some light showers which fell just before harvest time, thereby furnishing favorable conditions for the rot. Clean cultivation will have a tendency to reduce the amount of rot.

II. POWDERY MILDEW ON FIELD-GROWN CUCUMBERS.

In July, 1891, Humphrey[5] announced the occurrence of a powdery mildew on cucumbers in America. In his annual report[6] for that year he gave an extended account of the disease and stated that it had been found on hot house cucumbers at Fitchburg, Mass., and Ithaca, N. Y. His next annual report[7] contained drawings of the fungus and a brief recapitulation of the matter contained in the previous report. In Cornell Experiment Station Bulletin 31, page 31, Bailey has given a brief account of some experiments on the treatment of cucumber powdery mildew in the greenhouse.

So far as known to the writer, the above mentioned articles constitute the whole of the literature of powdery mildew on cucumbers in America. In the Ninth Massachusetts Report[8] Humphrey states that in America it is not known to him to attack cucumbers grown in the open air. It is therefore worthy of mention that in September, 1899, we received from F. L. Estabrook, of Athens, Pa., several leaves of field grown cucumbers which were thickly covered with a powdery mildew. Mr. Estabrook states that the mildew made its appearance some time in August and by September 22 was to be found upon every vine in the field and upon all parts of each vine excepting the younger leaves. In almost every case the older leaves near the root were the most severely attacked while the newer leaves toward the tip of the vine were generally free from it. The fungus was conspicuous and occurred chiefly upon the upper surface of the leaves but occasional spots of it were to be found upon the under surface. The fruits were exceedingly bitter and many were misshapen, but

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[5] Humphrey, J. E. The Powdery Mildew of the Cucumber. Mass. State Agr. Exp. Sta. Bul. 40: 3.

[6] Ninth Ann. Rept. Mass. State Agr. Exp. Sta., 1891: 222–226.

[7] Tenth Ann. Rept. Mass. Agr. Exp. Sta., 1892: 225–226.

[8] l. c., p. 222.

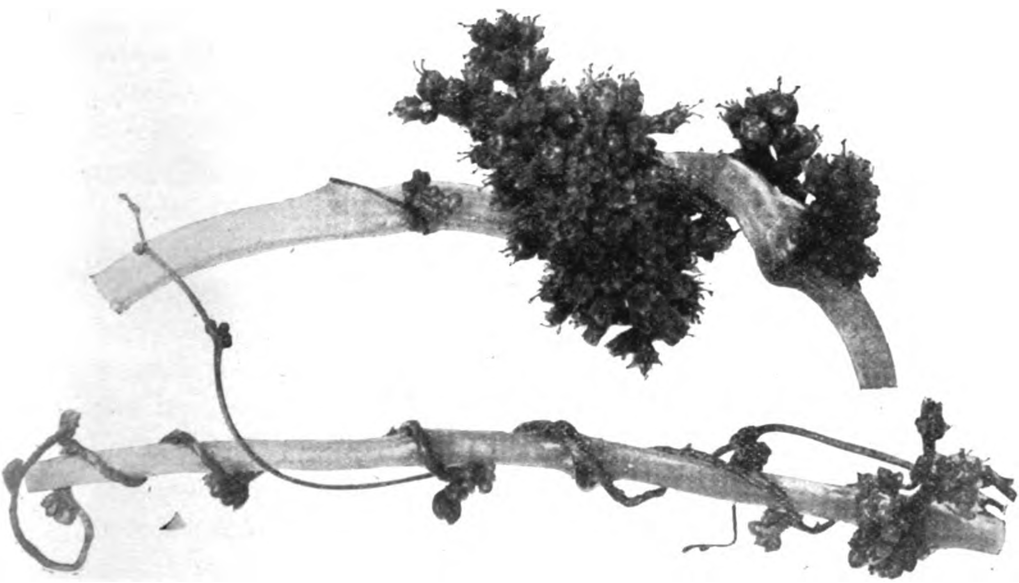

PLATE XII.—DODDER ON CUCUMBERS.

this may not have been wholly due to the powdery mildew. The plans were affected to a considerable extent also by downy mildew, *Plasmopara cubensis* (B. & C.) Humph.

Since no perithecia were found the identity of the fungus is a matter of conjecture. On his mildewed greenhouse cucumbers Humphrey found the perithecia of *Erysiphe cichoracearum* D. C. According to Frank[9] *Sphaerotheca castagnei* Lev. occurs on cucumbers in Europe, but the most common powdery mildew of cucumbers and other cucurbits in Europe is known only in the conidial form which passes under the name of *Oidium erysiphoides* Fr. Sturgis[10] assumes that the powdery mildew of the cucumber is identical with the one occurring on squash, but to us this appears extremely doubtful for the following reasons: The powdery mildew is common in this country on squash but on cucumber it is rare. During the past two seasons it has been abundant on both squashes and pumpkins in the vicinity of Geneva, but in no case have we observed it upon cucumbers, although cucumber vines have frequently been seen growing among mildewed squashes and pumpkins. *Vice versa,* on Mr. Estabrook's farm at Athens, Pa., a squash vine running among the mildewed cucumbers was entirely free from mildew.

Cucumber growers need not be alarmed at the appearance of this new parasite. It is not likely to become epidemic and in case it should do so it will probably not be found difficult to control.

III. DODDER ON CUCUMBERS UNDER GLASS.

The numerous species of dodder, *Cuscuta,* may be expected to occur on a great variety of plants in the open air, but it is unusual for them to attack greenhouse plants. An interesting case of dodder occurred in the Station cucumber-house last spring. In May, the writer observed a slender, yellow dodder thread twining about

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[9] Frank, A. B. Die Krankheiten der Pflanzen. 2: 260. Eduard Trewendt, Breslau, 1896.

[10] Sturgis, W. C. Twenty-First Ann. Rept. Conn. Agr. Exp. Sta., 1897: 214.

a cucumber plant. For a time it was permitted to grow unmolested in order to see what it would do; but it thrived so well and became so aggressive that the man in charge of the greenhouse found it necessary to take precautions to prevent it from spreading to the other plants. Four times during the spring the yellow threads were carefully removed. In spite of this rough treatment it flourished and fruited profusely and succeeded in thoroughly establishing itself upon four of the neighboring plants. The original host plant was greatly enfeebled by it, but not killed.

This dodder, which we have determined as *Cuscuta gronovii* Willd., may become troublesome unless dealt with vigorously. We advise the immediate destruction of affected plants.

IV. IS THE BALDWIN FRUIT SPOT CAUSED BY FUNGI OR BACTERIA?

There is a widely distributed and well known disease of the apple in which spots of brown, spongy tissue appear underneath the skin of the ripe fruit. On the surface of the fruit these spots are generally indicated by brown, more or less circular depressions having a diameter of from one-sixteenth to one-fourth of an inch. By different authors it has been given different names; *e. g.,* spot, brown spot,[11] dry rot,[12] bitter pit,[13] stippen,[14] etc.

This disease is of uncertain origin. Wortmann[15] thinks it due primarily to insufficient water in the affected parts. Most investigators have failed to find fungus hyphæ in the diseased tissue, but Jones[16] has attributed it to a fungus which Ellis determined as *Dothidea pomigena* Schw. Lamson[17] reports experiments in

11 Lamson, H. H. N. H. Agr. Exp. Sta. Bul. 65: 106. Illus.

12 Craig, John. Canada Exp. Farms Rept. for 1896: 171–172. Illus.

13 Cobb, N. A. Agr. Gaz. N. S. Wales, 9 (1898): 683. Illus.

14 Wörtman, Jul. Ueber die sogenannten "Stippen" der Aepfel. Landw. Jahrb., 21 (1892): 663–675.

15 Loc. cit.

16 Jones, L. R. A Spot Disease of the Baldwin Apple. Fifth Ann. Rept. Vt. Agr. Exp. Sta., 1891: 133–134.

17 N. H. Agr. Exp. Sta. Bul., 45: 46–47: Bul. 65: 106.

which the amount of the disease was considerably reduced by spraying with Bordeaux mixture. This, also, indicates a parasitic origin. On the other hand Craig[18] says that spraying does not seem to prevent it, and this coincides with our own limited observations.

The descriptions given by the several authors whose work is mentioned above agree quite closely, and yet it is highly probable that they have been dealing with two or more distinct diseases. We have here an illustration of the desirability of more complete descriptions of the gross characters of plant diseases.

During the past season the writer has made an investigation into the cause of one of these fruit-spot diseases of the apple. It is a disease of the Baldwin and is generally known throughout New York State as the "Baldwin spot" or "Baldwin fruit spot." Although it undoubtedly originated somewhat earlier, it was not observed until the fruit was gathered, about October 7. The owner of the orchard estimated that a trifle less than two per ct. of the fruits were affected; however, on individual trees the percentage was much higher than this. The orchard had been thoroughly sprayed four times — twice before and twice after blossoming. It was well cultivated and is in all respects one of the best managed orchards in the vicinity of Geneva.

On the surface of the fruit the spots were very conspicuous. They varied in color from light brown to dark brown. Their general shape was circular, but very few were perfect circles. Sometimes they were quite irregular, but always with the corners well rounded and sharply delimited from the healthy tissue. The spots were slightly sunken, with the epidermis smooth, shiny and unbroken. In size they varied from a mere speck to one-fourth inch in diameter, the majority having a diameter of about one-eighth of an inch. The smallest spots might show no brown color at all, but be indicated merely by a deeper red color of the skin if situated upon the colored part of the fruit, or by a green

[18] Loc. cit.

color if situated upon the lighter portion. The number of spots on individual fruits varied from two or three up to as many as seventy-five, distributed irregularly over the calyx half of the fruit. It is an interesting fact, and one which may throw some light on the cause of the trouble, that the stem half of the fruit is almost invariably free from spots even when they are numerous on the calyx half.

Underneath the surface spots the tissue is light brown, dry and spongy for a distance of one-eighth to three-sixteenths of an inch. This spongy tissue is not bitter to the taste[19] or at least but slightly so. At the time the fruits were gathered the spongy tissue was found only underneath the surface spots, but after they had lain some three weeks in the laboratory many brown spots were found distributed irregularly through the flesh of the calyx half of the fruit, but not in the stem half. These spots were irregular in shape, indefinite in outline and in many cases entirely surrounded by healthy tissue.

Several other varieties of apples of this State are affected with spots similar to those on the Baldwin, but the following study was confined to the Baldwin spot here described, and the conclusions apply to this one form only.

Microscopic examination of the affected tissue revealed no fungus hyphæ and no bacteria which could be definitely demonstrated as such. Commencing October 7, two of the affected Baldwins were kept for 21 days in a moist chamber at a temperature of 65° to 74° Fahr. During this time the spots did not enlarge (externally, at least), no fungus appeared upon them and they did not increase in number upon the surface although they did increase in number *within* the fruit.[20] When these apples

19 This is a point on which the spot disease under consideration differs from the descriptions of Jones and Cobb.

20 The reason for believing that the spots increased in number within the fruit, is as follows: When the apples were taken from the trees, many of them were cut open, and in no case were the spots found, except immediately under the epidermis; but after affected apples from the same lot had been off the trees for about three weeks, they universally showed brown spots scattered through the flesh quite to the core.

finally rotted the rot started on the stem half instead of the spot-affected calyx half. At another time, two affected apples were kept in a moist chamber for 18 days with the same results.

Next, an experiment was made to determine if the diseased tissue would produce any growth when placed in culture media. Four Petri dishes[21] containing potato agar slightly acidified with lactic acid were each inoculated at three different points with small pieces of the brown spongy tissue. This gave twelve points of inoculation with material from twelve different spots. The cultures were kept at the room temperature, about 70° Fahr. At the end of eight days one point of inoculation was overrun by a fungus which had gained admission to the culture by accident. The other eleven points of inoculation were entirely free from growth of any kind.

On November 1 six tubes of neutral beef-peptone agar were inoculated with small pieces of the brown, spongy tissue taken from six different spots, and then poured into Petri dishes. At the end of eight days the only growth in the six dishes consisted of one fungus and two yeast colonies which were evidently intruders. We now tried cultures in an atmosphere devoid of oxygen. Six tubes were used — two of potato agar, two of beef-peptone agar and two of beef-peptone agar containing two per ct. of lactose. One tube of each kind was slightly acidified with malic acid and the other left neutral. The six tubes were inoculated with bits of spongy tissue from six different spots, thoroughly shaken and placed in a large bottle from which the oxygen was then removed by means of pyrogallic acid and potassium hydroxide solution. These cultures were kept at a temperature of about 80° Fahr. for one week but they produced no growth whatever.

Finally, at the suggestion of Mr. H. A. Harding, Station Bacteriologist, we tried apple peptone agar[22] as a culture medium.

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[21] Two dishes acidified at the rate of one drop of 50 per cent. lactic acid to 10 c. c. agar, and the other two dishes at double this rate.

[22] Baldwin apple, 400 germs. Witte's peptonum siccum, 10 germs. Agar, 15 germs. Water, 1 liter.

Three tubes of this medium carefully neutralized with sodium hydroxide, and three tubes unneutralized were inoculated with the spongy tissue and kept 24 days in air at a temperature of about 80° Fahr. Six other tubes of the same medium, three neutralized and three unneutralized, were inoculated and kept for the same length of time at a temperature of about 80° Fahr. in an atmosphere devoid of oxygen. No growth appeared in any of the twelve tubes.

From the result of this study we conclude that the form of apple fruit-spot described above is not caused by fungi or bacteria, but what the real cause may be we are not prepared to state.

Wortmann[23] observed that starch is present, often in considerable quantity, in the brown, spongy tissue, while the surrounding healthy tissue is almost, if not wholly, destitute of starch. We find that the spongy spots lying just beneath the epidermis generally contain considerable starch, but the deeper-lying spots (which, as has been stated, are formed after the fruit is gathered) rarely contain more than traces. This difference in starch content is brought out very strikingly when a section of apple showing both kinds of spots is smeared with a solution of iodine and potassium iodide. The sub-epidermal spots become black, showing the presence of starch, while the interior spots are not altered in color.

When an apple is bruised without breaking the epidermis the tissue becomes brown and spongy and resembles somewhat the brown, spongy spots under discussion. We have found this bruised tissue loaded with starch, while the surrounding uninjured tissue contained no starch. Green apples contain starch which is changed into sugar as the fruit ripens. It, therefore, seems probable that the bruises which responded to the test for starch were made before the fruit was ripe. Upon the death of the cells their activities ceased and the transformation of starch into sugar was arrested. This theory accounts for the absence of starch from late formed spots.

23 Loc. cit., p. 663.

FIG. 1.—BALDWIN APPLE AFFECTED WITH FRUIT SPOT.

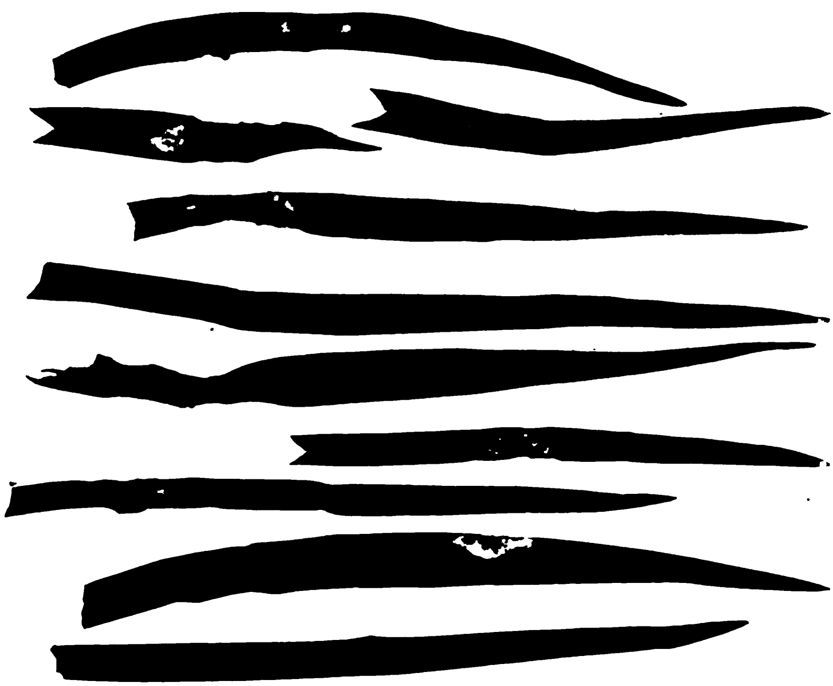

FIG. 2.—CARNATION LEAVES AFFECTED WITH *Fusarium* LEAF-SPOT.

PLATE XIII.

An experiment was made to determine if bruises made after the fruit was ripe would cause the appearance of starch in the bruised tissue. On December 6, apples of the variety Pride of Texas were bruised without breaking the epidermis, and then kept at a temperature of 60°F. At the end of three weeks the bruised tissue contained a little starch, but the quantity was very small as compared with that found in old bruises on the same variety.

V. A FUSARIUM LEAF-SPOT OF CARNATIONS.

A very unusual case of *Fusarium* attacking carnation foliage was observed in a greenhouse at Syracuse last November. A bench of carnations of the variety Emily Pierson was quite seriously affected with a peculiar leaf-spot. The spots varied in length from one-eighth of an inch to one inch. The smaller ones were elliptical, but the larger ones occupied the entire width of the leaf and were irregular at the ends. They were covered with a pinkish gray mold and irregularly dotted at the center with the light yellow spore masses of a species of *Fusarium*. Many of the worst affected leaves were dying. The *Fusarium* was evidently parasitic on the leaves, but a careful examination revealed the fact that in every case the spots originated in a rust[24] sorus. It appeared that the *Fusarium* was unable to attack the uninjured leaf, but when the epidermis was broken by rust it was able to enter and bring about decay of the leaf tissue. It is improbable that the *Fusarium* is parasitic upon the rust.[25]

The writer has occasionally observed *Fusarium* attacking injured leaves and stems of carnations and the spore masses of a similar *Fusarium* are common on the stems of carnations affected

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[24] *Uromyces caryophyllinus* (Schrank) Schroet.

[25] In this connection it may be mentioned that Mr. F. H. Blodgett, Assistant Botanist and Entomologist, observed at Mattituck, N. Y., last August, a *Fusarium* growing abundantly on the uredo sori of *Puccinia asparagi*, D. C. However, in this case, the *Fusarium* was not confined so strictly to the rust sori, but occurred also upon the so-called leopard spots and sometimes even upon the uninjured asparagus stems.

with that form of stem-rot commonly known as dry rot or die back;[26] but we have never before known *Fusarium* to produce a genuine leaf-spot of carnations. Inoculation experiments may show that this *Fusarium* is identical with the one causing carnation stem-rot.

The plants were grown under conditions exceptionally favorable to the attack of fungi. They were so situated that direct sunlight never reached them. However, they were doing fairly well and were free from disease with the exception of the *Fusarium* leaf-spot and a moderate attack of rust.

VI. *CHAETOMIUM CONTORTUM* ON BARLEY SEEDLINGS.

In March, 1895, the writer found a new species of *Chaetomium* on some lily bulbs in a greenhouse on Long Island. The fungus was sent to Dr. C. H. Peck, State Botanist, who named it *Chaetomium contortum.*[27] For nearly four years after this nothing was heard of it; then it was again found in one of the Station greenhouses. In December, 1898, some barley seedlings used in an experiment on plant nutrition began to languish without apparent cause. Upon making an examination of the diseased plants it was found that several perithecia of *Chaetomium contortum* were seated on the seed pericarps which still remained attached to the young plants. So far as known none of the species of *Chaetomium* are parasitic, but this case was so suspicious that it was decided to test the matter by experiment. Fifty seeds of barley were planted in each of two boxes in sterilized soil. One of the boxes was inoculated at three points with pure cultures of the *Chaetomium*

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[26] For an account of the *Fusarium* stem-rot of carnations, see: Sturgis, Wm. C. Preliminary Investigations on a Disease of Carnations. Twenty-First Ann. Rept. Conn. Agr. Exp. Sta., 1897: 175–181. Also, Stewart, F. C. The Stem-Rot Diseases of the Carnation. Bot. Gaz., 27: 129–130.

[27] Forty-Ninth Ann. Rept. N. Y. State Museum. Report of State Botanist, p. 24.

and the other used as a check. When they had reached a height of six to eight inches the plants were all in perfect health. Nevertheless, upon pulling them up it was found that a majority in both boxes had perithecia of *Chaetomium contortum* on their pericarps. This proved that the *Chaetomium* was not parastic. The spores must have become attached to the barley seeds before they were planted.

A FRUIT-DISEASE SURVEY OF THE HUDSON VALLEY IN 1899.*

F. C. STEWART AND F. H. BLODGETT.

SUMMARY.

This bulletin contains an account of the fruit diseases occurring in the Hudson Valley in 1899. The various diseases are considered individually with reference chiefly to their distribution and the amount of damage done; but descriptions and additional notes have been given wherever it has been thought that they would be of interest either to the fruit-grower or the vegetable pathologist.

The data have been obtained by two methods: (1) From replies to letters of inquiry sent to fruit-growers, and (2) From personal observations made by the authors.

The season has been an unusually dry one and as a consequence fruit of all kinds has been remarkably free from disease. Some of the diseases usually very common and destructive have, this season, done little or no damage.

Apples have suffered from no disease — not even from scab. Rust has been the worst disease of blackberries. It has a tendency to reduce the number of prickles. Cherries have suffered most from fruit-rot which has been severe in a few localities. In the Hudson Valley black knot is common on the cultivated cherries but does not occur on the wild black cherry. Cane blight has been the worst disease of currants. In the Hudson Valley it is not

* Reprint of Bulletin No. 167.

caused by *Nectria* but by a sterile fungus. It is wide spread and destructive. The four-lined leaf-bug causes a currant leaf-spot which is confused with that due to fungi. An obscure dewberry disease was observed. Gooseberry powdery mildew has been troublesome in Ulster and Columbia counties. A gooseberry root rot has been found at Marlboro. Grape black rot has done serious damage in a few instances. Grape root rot due to *Dematophora* and grape black knot occurred in Orange Co. Winter injury to fruit-buds caused heavy losses to peach growers. Peach leaf curl has been conspicuous by its absence, but the yellows is common. Pears have suffered from no disease. In former years black knot ruined the plum orchards, but it has probably not spread much in 1899. Plum fruit-rot has been destructive. Quinces have been affected considerably with fruit-spot and leaf-blight. The worst disease affecting the raspberry this season is an obscure one which may be caused by *Phoma*. Raspberry anthracnose was rare on new canes, but abundant on fruiting canes. Strawberry leaf-blight has been severe on some varieties. None of the above diseases were so destructive as in 1898.

INTRODUCTION.

Since its organization, in 1897, the Eastern New York Horticultural Society has had a standing committee on plant diseases. The membership of this committee is a follows: F. C. Stewart, Geneva; F. A. Taber, Poughkeepsie; E. W. Barns, Middle Hope; P. W. King, Athens; and L. E. Covert, Clintondale.

The two published reports[1] of the Committee are brief for two reasons; namely, lack of data and lack of space for publication. During the past season the committee has endeavored to do more thorough work. A considerable amount of data has been gathered, and to present it in as much detail as seems desirable would

[1] Fifty-Seventh Ann. Rept. of the N. Y. Agr. Soc., 1897: 735–738.

make a longer paper than the Society would be willing to publish in its Proceedings. Moreover, much of the matter is of more than local interest, making it desirable to publish it where it will have a wider circulation than has the Proceedings of the Society. Hence the publication of this bulletin.

THE SURVEY: METHODS AND GENERAL RESULTS.

TERRITORY COVERED BY THE SURVEY.

The territory covered by the survey includes only the counties bordering upon the Hudson River between Albany and New York City; namely, Albany, Rensselaer, Greene, Columbia, Ulster, Dutchess, Putnam, Orange, Rockland, and Westchester counties. In order that the region investigated might be as nearly as possible a natural plant region, and yet cover the greater part of the territory included in the membership of the Society, Long Island and Staten Island were excluded. The usual climatic conditions prevailing there are markedly different from those which obtain in the Hudson Valley. The district under consideration is about 160 miles in length and 45 to 50 miles in width with the Hudson River running through the middle. (See Plate XIV.)

WEATHER CONDITIONS.

It is well known that weather conditions, especially rainfall and temperature, exert a powerful influence upon the growth of fungi. Fungous diseases of plants are much more destructive in wet seasons than in dry ones. In the Hudson Valley, the spring and summer of 1899 were unusually dry and the temperature somewhat higher than normal, offering a marked contrast to the season of 1898, which was very wet. The monthly precipitation for the season of 1899 is shown in the accompanying table:

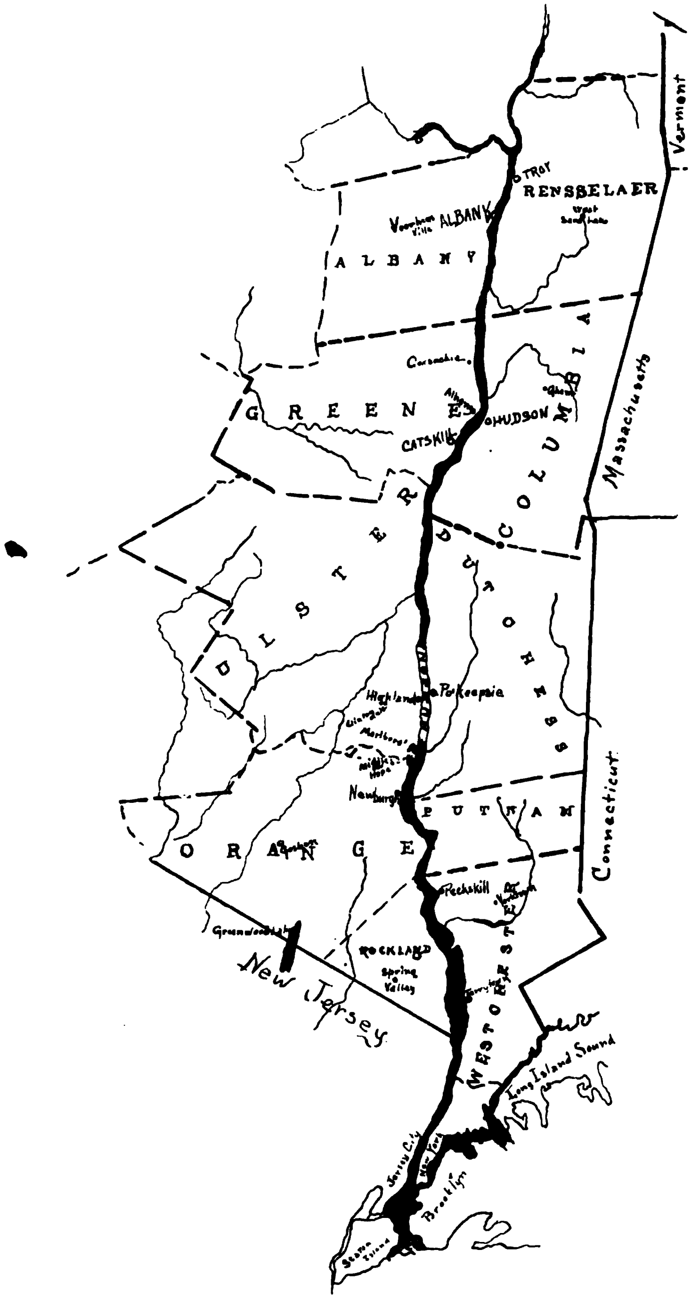

Plate XIV.—Territory Included in Survey.

PRECIPITATION IN THE HUDSON VALLEY.—APRIL TO SEPTEMBER, 1899.[2]

Station.	April.	May.	June	July.	Aug.	Sept	Total for six mos.
	In.	In.	In.	In.	In.	In.	In.
Albany	1.03	2.23	1.61	2.69	1.77	6.23	15.56
Catskill	2.26	2.12	1.24	3.59	2.21	6.49	17.91
Poughkeepsie	0.20	1.27	1.74	5.56	1.68[3]	4.99	15.44
West Point	1.70	2.31	4.85	5.78	1.90	6.39	22.93
Bedford	2.11	2.36	4.73	6.65	0.89	5.03	21.57

METHODS OF OBTAINING DATA.

It is a favorite method with plant disease committees to send out circulars of inquiry to fruit growers asking for information concerning fruit diseases which have appeared during the season. We have done this and gotten considerable valuable information; but this method is applicable only to a few of the most common and best known diseases. In the first place the majority of fruit growers will pay no attention to such a circular. Out of a total of 250 circular letters enclosing self addressed envelopes for the reply we have had returned to us only 59. Secondly, the replies are often misleading. They are usually based not upon careful observations properly recorded, but upon loose general impressions. Furthermore, the laity are able to identify accurately only a very few diseases. Frequently, two or more distinct diseases pass under one common name. Blight, leaf-spot, rust, fruit-rot and root-rot are examples of this. What is commonly called pear leaf-spot is caused by two quite different fungi, but there are very few persons not experts who know the difference between them. We have in New York, three fungous diseases and an insect trouble which are covered by the one common name, currant leaf-spot. Even so well known a disease as peach leaf curl is sometimes confused with the distortions caused by plant lice.

[2] The records for April, May, and June, are taken from the U. S. Monthly Weather Review; those for July, August, and September, from the N. Y. Climate and Crop Service monthly reports.

[3] The August record for Poughkeepsie is lacking; the figures here given are for Wappinger's Falls, the nearest record station.

Appreciating the limitations and inaccuracies of the circular-letter method, the committee planned to supplement the data obtained in that way with data obtained from observations made by experts. For this purpose the Chairman associated with himself Mr. F. H. Blodgett, Assistant Botanist and Entomologist, who made three two-day and three three-day trips to different localities in the southern half of the district for the purpose of inspecting fruit plantations, taking notes on fruit diseases and collecting specimens. The Chairman made six similar trips of inspection to localities in the northern half of the district.

This combination of circular-letter method and expert inspection is a good one. The two methods supplement each other admirably.

The following is a copy of the circular letter sent to fruit growers, the spaces for answers being omitted:

CIRCULAR LETTER OF INQUIRY SENT TO FRUIT GROWERS.

GENEVA, N. Y., *Nov.* 15, 1899.

DEAR SIR.— The undersigned, a Committee on Plant Diseases, appointed by the Eastern New York Horticultural Society, wish to get together information in regard to the most troublesome diseases prevalent the past season among orchards, vineyards and nurseries in the Hudson River Valley. They issue the following circular in the hope that prompt replies may enable them to prepare a valuable report for the next meeting of the Society. Will you kindly fill out the blanks below and return at once? Please answer only those questions concerning which you can give positive information. Address your reply to the chairman, F. C. Stewart, Geneva, N. Y.

1. Which of the following plant diseases have caused serious injury in your locality during the past season—

ORCHARD DISEASES.

Apple.

Pear blight (Fire blight).
Scab.
Leaf spot.

Pear.

Leaf blight.
Pear blight (Fire blight).
Scab.

Quince.

Fruit spot and leaf blight.
Pear blight (Fire blight).

Plum.

Black knot.
Fruit rot.
Leaf blight.

Peach.

Fruit rot.
Leaf curl.
Yellows.
Little peach.

Cherry.

Fruit rot.
Leaf blight.

NURSERY DISEASES.

Apple.
Powdery mildew.

Pear.
Leaf blight.
Pear blight (Fire blight).

Cherry.
Leaf blight.
Powdery mildew.

Plum.
Leaf blight.

Quince.
Leaf blight.

Peach.
Root knot.
Powdery mildew.

VINEYARD DISEASES.

Black rot.
Downy mildew (brown rot or gray rot).
Powdery mildew.
Anthracnose.
Rattling or shelling.

SMALL FRUITS.

Raspberry.
Anthracnose.

Strawberry.
Leaf blight.

Currant.
Leaf blight.
Cane blight.

Gooseberry.
Mildew.

2. Of the diseases mentioned, please name the worst three.

3. In each of the above cases, give, if possible, the percentage of the crop injured, stating the basis upon which you make your estimate.

4. What remedies, if any, have been used for plant diseases in your locality?

5. With what success have these been used?

6. Have any new or unusual diseases appeared; if so, give description, amount of damage done, and any other items concerning them.

F. C. STEWART,
F. A. TABER,
E. W. BARNES,
P. W. KING,
L. E. COVERT,
Committee.

MAGNITUDE OF THE FRUIT INDUSTRY.

Fruit growing is one of the leading industries throughout the whole district. In several localities it is practiced to the exclusion of all other branches of agriculture. The most prominent of these special fruit growing localities is in the southeastern part of Ulster County around Marlboro, Milton and Highland.

The fruits grown extensively are apples, cherries, currants, grapes, peaches, pears, raspberries and strawberries. There are several commercial plantations of gooseberries, blackberries and

quinces. Plums are grown to a considerable extent, but not so much as formerly. Apricots and dewberries are rare.

There are but few nurseries in the district.

GENERAL STATEMENT OF RESULTS.

Fruits generally have been remarkably free from diseases of all sorts.[4] Nearly all fruit growers with whom we have talked upon the subject say that all fruits have been freer from disease the past season than for many years. There has not been an epidemic of any disease and some of the common destructive diseases have been almost entirely absent. Fruit diseases have been conspicuous by their scarcity. Consequently, quite as much is said in this bulletin about what has *not* been found as what *has* been found.

It is to be regretted that a thorough survey of fruit diseases in the Hudson Valley was not made in 1898. The season of 1898 was very wet and fruit diseases generally were unusually destructive. A comparison of the two seasons would be instructive.

The replies to questions two and six of the circular letter were so few and so unsatisfactory that they have not been considered. The replies to questions four and five indicate that Bordeaux mixture, although used to a considerable extent, is not in as general use as it should be.

APPLE DISEASES.

In quantity, the apple crop of 1899 was, perhaps, no more than an average one; but the fruit was remarkably fair, being unusually free from blemishes of all sorts. Nevertheless, apples have not kept well. This is due partly to the warm autumn[5] and partly to the fact that the fruit ripened prematurely. Certain winter varieties, for example Baldwins and Greenings, have in some cases behaved more like late fall varieties.

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[4] This statement does not apply to insect injuries.

[5] It is believed by some that the very heavy frost on October 3 (25° at Honeymead Brook, 27° at Wappinger's Falls), seriously injured the keeping qualities of apples.

SCAB.

(*Venturia inaequalis* (Cke.) Adeh. Syn. *Fusicladium dendriticum* (Wallr.) Fckl.)

This arch enemy of the apple has done very little damage. It has been reported as occurring to a slight extent in all the counties in the district except Albany, Ulster and Putnam, but only one correspondent (Old Chatham, Columbia Co.) reports it troublesome. On June 20 we sought in vain for a single specimen of scab in an 80-acre apple orchard at Poughkeepsie. In 1898 this orchard suffered severely from scab. At Washingtonville scab spots were common on the twigs of the Lady apple, which is a variety very susceptible to this form of attack.

LEAF SPOT.

(*Phyllosticta* spp.)

What a correspondent thought to be leaf spot occurred injuriously at Schodack Landing, Rensselaer Co. In some orchards 25 per ct. of the foliage was affected. Upon investigation it was found that the so called leaf spot was the work of an insect,[6] the resplendent shield-bearer (*Aspidisca splendoriferella*).

The true fungus leaf spot has been much less common than scab, but traces of it have occurred at various points in the district. No attempt was made to distinguish between the two species.

TWIG BLIGHT.

(*Bacillus amylovorus* (Burr.) DeToni.)

Rare. A few affected twigs were observed in Albany Co.; and three correspondents, one each in Orange, Ulster and Rensselaer counties, report its occurrence in small quantity.

[6] On the authority of Mr. F. A. Sirrine, who examined some of the affected leaves.

CANKER.[7]

(*Sphaeropsis malorum* Pk.)

This disease has killed a good many Spitzenberg trees in the vicinity of Voorheesville and New Scotland in Albany Co. It occurs destructively at Pomona and Blauvelt in Rockland Co. At Blauvelt it is especially troublesome on the variety Sour Bough. It has also been observed at Yorktown and Poughkeepsie.

SOOTY BLOTCH.

(*Phyllachora pomigena* (Schw.) Sacc.)

Rare. A little found on apples received from Newburgh and Yorktown.

RUSSETING OF FRUIT.

Russeted apples are reported to have been common in the vicinity of Hudson. We have seen the disease on Baldwins and Ben Davis at Poughkeepsie. The affected fruits were frequently misshapen and showed irregular areas on which the skin was rough and light brown in color. This appearance is sometimes due to spraying and sometimes to weather conditions alone.[8] It is often incorrectly called rust.

RUST.

(*Gymnosporangium* spp. Syn. *Roestelia* spp.)

This is a fungous disease in which circular yellow spots appear on the leaves in June. It may attack the fruit also. The red cedar, the host of the teleuto stage of the fungus, grows spontaneously throughout the entire district and "cedar apples" were found quite commonly upon it during early May in Ulster and Rockland counties; but the æcidial stage upon the apple has been entirely absent.

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[7] For an account of Apple Canker, see Bulletin 163 of this station.

[8] See Bulletin 84 of this station, pp. 29–33.

SUN-CRACK.

On June 2 some apple-tree trunks were observed at Ghent on which the bark was loose and dead over areas from two to four inches in width and from one to four feet in length. These injuries were on the southwest side of the trunks and usually, but not always, extended quite to the ground. It first appeared in the spring of the present year. The trees were unusually thrifty, about seven years old and of the variety Willow Twig. They stood in well drained soil. We are of the opinion that it was caused by the sun's rays heating the bark intensely in early spring while the soil about the roots was still deeply frozen. That is to say, this is a case of what Hartig[9] calls sun-crack (*Sonnenriss*).

A sun-crack or perhaps sun-scald of apple tree trunks locally known as "southwest blight" is of common occurrence in the vicinity of Washingtonville.

BROWN, SUNKEN SPOTS ON THE FRUIT.[10]

A disease of this description has been reported as occurring on Greenings and Baldwins at Clintondale.

APRICOT DISEASES.

Apricots are not cultivated to any extent within the district. The only disease with which we met was one occurring at Ghent. Some trees which have been planted for several years have been dying off mysteriously one at a time for a few years past. A tree may die either in part or wholly at any time during the growing season. Some died in the spring of 1899. Just above the surface of the ground the bark is dead, often for considerable distance up the trunk; but the wood is not laid bare. Sometimes the bark shrinks

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[9] Hartig, R. Text-Book of the Diseases of Trees (p. 296). Translated and revised by Somerville and Ward. The Macmillan Co.: New York, 1894. Dr. Hartig informs us that Fig. 159, which purports to illustrate sun-crack, is misnamed. The injury was caused by lightning.

[10] A description of this disease and an account of an investigation into its causes are given in Bulletin 164 of this station.

tightly to the wood. Between the bark and the wood there may be much fungus mycelium, probably the mycelium of *Irpex lacteus* Fr. since pilei of that fungus were found on one of the dying trunks. One of the diseased trees was dug up for the purpose of examining the roots, which were seemingly healthy and free from fungus. There was no sharp line of demarcation between the diseased and healthy wood at the point where the scion joined the stock.[11] The trees were thrifty, having been well cultivated and cared for. The cause of this disease is unknown to us. It occurs in other parts of the state, sometimes causing heavy losses.

BLACKBERRY DISEASES.

ORANGE RUST.

(*Puccinia peckiana* Howe. Syn. *Caeoma nitens* Schw.)

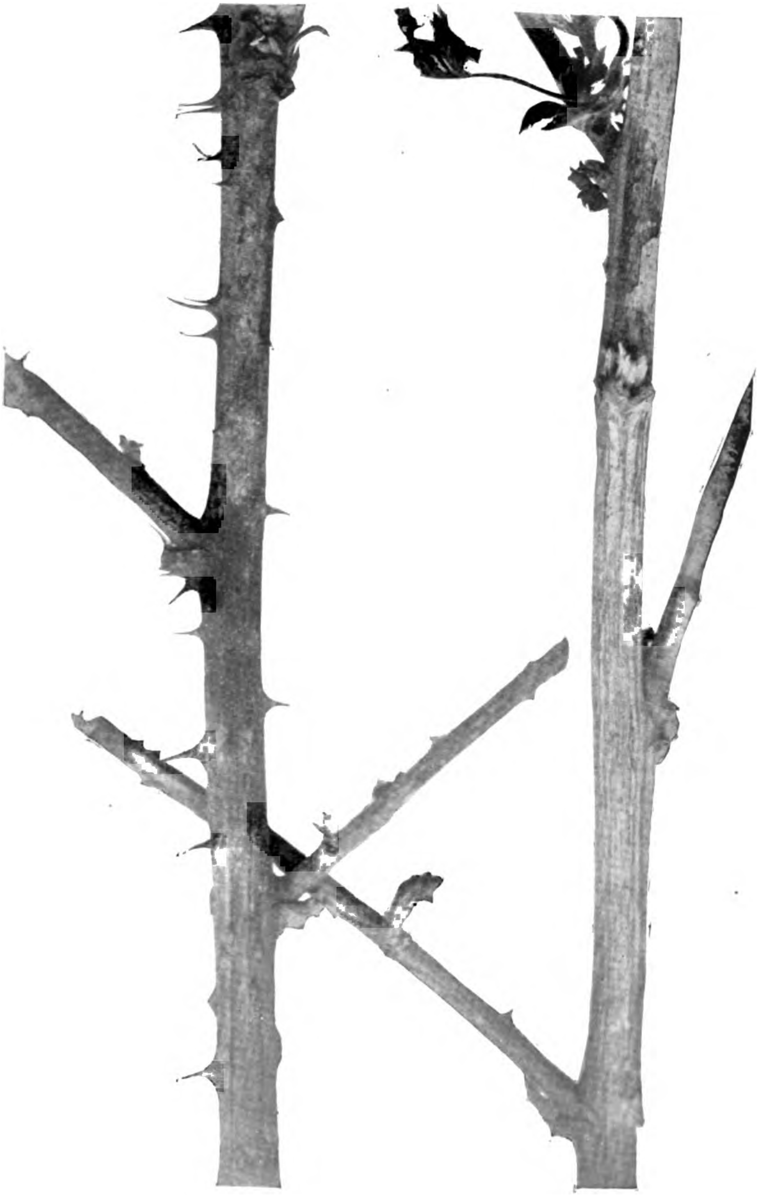
Orange rust, although less distructive than usual, was abundant and undoubtedly the worst blackberry disease. For several years W. D. Barns & Son of Middle Hope have persistently fought the disease by digging out and burning the affected plants. It is probable that this treatment has materially lessened the ravages of the disease, but in spite of their efforts it continues to cause considerable damage every season. To get the best results from such treatment the diseased plants should be removed promptly upon the first appearance of the disease to prevent the spores from ripening.

At Mr. Barns' place our attention was called to an interesting effect which rust has upon the canes of raspberries and blackberries. *Canes affected with rust were much freer from prickles*[12] than were healthy canes.

These observations were made on May 8, at which time the rusty canes of the preceding season's growth were easily recognized although the æcidiospores were not yet mature. Among black-

11 The stock was peach.

12 No reference to this phenomenon has been found in the literature at hand. Mr. W. Paddock informs us that he has observed it at Oaks Corners, Ontario county.



HEALTHY. RUSTED.

PLATE XV.—A HEALTHY AND A RUSTED BLACKBERRY CANE FROM THE SAME HILL.

berries of the variety Wilson Jr., the rust-affected canes were almost or even wholly destitute of prickles. It is not an uncommon thing to find healthy canes and rusted canes of blackberry in the same hill.[13] Such cases offered an opportunity for close comparison and it was found that the difference in the number of prickles on the two sorts of canes in the same hill was very marked. (See Plate XV.) The difference is so great that Mr. E. W. Barns says he can pick out the diseased canes in winter by their freedom from prickles. On affected raspberry canes the reduction of prickles was very evident but not so marked as with the blackberry.

After these observations at Middle Hope, we examined, during the season, many rusty blackberries, raspberries and wild dewberries (*Rubus canadensis* L.) in various localities. With all of these plants we found that rust in some cases caused a great reduction of prickles; in other cases, partial reduction; and in still others, no reduction at all. At Yorktown badly rusted blackberries of the variety Minnewaska were observed which showed no apparent reduction of prickles.

LEAF SPOT.

(*Septoria rubi* Westd.)

Rare. Observed only at Poughkeepsie.

CHERRY DISEASES.

FRUIT ROT.

(*Monilia fructigena* P.)

As usual, fruit rot has been the worst cherry disease, but was not nearly so destructive as in 1898. From Westchester Co. it is reported "bad on some varieties." In Rockland Co. it destroyed

[13] This has also been observed by Clinton; Orange Rust of Raspberry and Blackberry. Ill. Agr. Exp. Sta. Bul. 29: 276. D. 1893. It occurs less commonly with the raspberry, probably on account of the more compact habit of growth at the crown.

about 25 per ct. of the latest sweet cherries. Orange Co. correspondents report but little damage from it. At Kinderhook, Columbia Co., it was "unusually developed." In the vicinity of Delmar, Albany Co., it is reported to have destroyed about 10 per ct. of the crop; and in one orchard about 50 per ct. A correspondent at Highland, Ulster Co., reports the loss of one-half his crop; but from personal observations we would say that, in general, cherries suffered but little from rot in that locality.

LEAF SPOT.

(*Cylindrosporium padi* Karst.)

This disease has occurred in small amount over the whole district, but no case has been reported in which it has done serious damage.

BLACK KNOT.

(*Plowrightia morbosa* Sacc.)

Throughout the Hudson Valley black knot is common on cultivated cherries of some varieties. English Morello probably suffers most. Trees of this variety are frequently ruined by it. At Middle Hope, Orange Co., Montmorency and Early Richmond cherries are said to knot considerably. At Coxsackie, Greene Co., we found knots on English Morello cherries producing summer spores as early as June 1. Black knot is exceedingly common on plums over the whole district. In former years it has been a veritable scourge. With these facts before us it is an interesting observation that, although the wild black cherry, *Prunus serotina* Ehrh., is very common and we have searched carefully, *not a single specimen of black knot has been found upon it.*[14]

The wild red cherry, *Prunus pennslyvanica* L. f., is common in Albany Co., but we have failed to find any affected by black

[14] Peck, also, has noted the absence of black knot from *Prunus serotina* in Eastern New York. See Forty-Second Ann. Rept. N. Y. State Mus. Nat. Hist., 1888: 125. On Long Island, black knot is abundant on this species.

knot. In the central part of Rensselaer Co. we have examined the choke cherry, *Prunus virginiana* L., which grows wild there, but found no knots upon it. However, at Washingtonville, Orange Co., the latter species is said to be much affected.

What has been said applies only to old knots. The observations furnish no information as to the number of knots produced by infections occurring in 1899, for the new knots do not appear until late in autumn, after the time when the survey was finished.

WITCHES' BROOMS.

(*Exoascus cerasi* (Fckl.) Sadeb.)

Knowing that this disease is not uncommon in some other parts of the State[15] we expected to find it in the Hudson Valley, but failed to find a single specimen.

POWDERY MILDEW.

(*Podosphaera oxyacanthae* (D. C.) De By.)

On July 20, a single bearing cherry tree affected with powdery mildew was observed at Delmar, Albany Co. A few leaves at the ends of the twigs were affected.

FUNGUS ON DEAD TRUNKS.

(*Irpex lacteus* Fr.)

On a fruit farm at Middle Hope we observed many dead cherry trees bearing numerous pilei of *Irpex lacteus* Fr.[16] The trunks were from three to five inches in diameter and in many cases were thickly covered with the fungus to a height of from three to five feet. The owner explained that the trees were of the variety Elkhorn, which is not hardy. Most of the trees had died during the past three or four years, apparently from winter injury.

[15] See Fourteenth Ann. Rept. of this station, 1895: 532–533; also, Fifteenth Rept., 1896: 459. In May, 1899, we found a single large specimen on an oxheart cherry (*Prunus avium*), at Sodus Center, in Wayne county, about five miles from the shore of Lake Ontario.

[16] Identified by Dr. C. H. Peck.

The fungus probably had nothing to do with the death of the trees. It is mentioned here because it is a conspicuous thing which might be mistaken for a parasite.

WINTER INJURY.

At Athens, Greene Co., three cherry trees 15 years old died mysteriously. They had been very thrifty, but last spring when the leaves were partly grown the trees suddenly died. They grew in a slight depression where water stands in wet seasons. It is likely that the trees went into the unusually severe winter of 1898–9 with "wet feet" and were winter killed. This theory is supported by the fact that another tree of the same age and variety standing only about 16 feet away but outside of the depression was not affected. Some pear trees standing within the depression and close beside the dead cherry trees were not killed.

Another case of what we consider to be winter injury occurred at Monsey in Rockland Co. Some cherry trees which had been planted in the spring of 1898 and made a vigorous growth that season were found badly injured in the spring of 1899. A few of the trees were killed outright, but with a majority of them only the branches were killed back for a distance of from 12 to 24 inches from the tips. The affected portions did not put out leaves. Trees standing in exposed situations suffered most. The owner thought that the injury might have been caused by bands of tarred paper which had been placed about the bases of the trunks to protect them from mice; but this theory is made untenable by the observation that the bark under the tarred paper bands was perfectly healthy.

Some other cases of the unaccountable dying of branches in cherry trees may also be due to winter injury.

A BRANCH PARASITE.

(*Polyporus sulphureus* (Bull.) Fr.)

On a cherry tree in Greene Co., five pilei of this fungus were found on the uninjured bark of a large limb which was rapidly dying. The fungus was apparently parasitic.

CURRANT DISEASES.

LEAF SPOT.

The fungi which cause leaf spot of currants in the Hudson Valley are *Septoria ribis* Desm., *Cercospora angulata* Wint., and *Gloeosporium ribis* (Lib.) Mont. & Desm. During the season of 1899 none of these did any damage worth mentioning. Only traces of fungous leaf spot were found in a few localities. Experiments by Pammel,[17] Goff,[18] and others have shown that at least the first two and most common of these fungous leaf spot diseases can be controlled by spraying with Bordeaux mixture. However, at various times complaints have been received that spraying does not prevent currant leaf spot.

The observations in the Hudson Valley throw some light on the cause of these failures. One of the best informed fruit growers in Columbia County called our attention to a bad case of currant leaf spot which he had tried in vain to prevent by spraying with Bordeaux mixture. Several thousand currant cuttings had been sprayed with Bordeaux during the first week in May and again about two weeks later. In spite of this treatment the plants were severely attacked during the last week in May by a disease which the owner did not doubt was the fungous leaf spot said to be amenable to treatment. An examination of the affected plants revealed the fact that the trouble was entirely the work of the four-lined leaf-bug,[19] *Poecilocapsus lineatus.* The leaves were thickly covered with small, reddish-brown, angular spots. In the early stage the spots were black and water soaked in appearance, but they soon became brown, dry and transparent. (See Plate XVI, fig. 1.) The epidermis, on both sides of the leaf, was depressed, but no gnawing of the tissue was evident. The insect thrusts its beak into the leaf and sucks out the juices.

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[17] Pammel, L. H. Iowa Agr. Exp. Sta. Bul. 13: 45–46; Bul. 17: 419–421; Bul. 20: 716–718; Bul. 30: 289–291.

[18] Goff, E. S. Wis. Agr. Exp. Sta. Bul. 72: 30.

[19] For an account of the habits, life history, etc., of this insect, see Cornell Agr. Exp. Sta. Bul. 58. O. 1893.

Later, the work of the same insect was found sparingly at Kinderhook, Highland and Clintondale and very abundantly at Tarrytown; but in all these cases on bearing bushes.

It seems probable that the injuries of the four-lined leaf-bug are often mistaken for fungous leaf spot. Currant growers should learn to distinguish between these two kinds of leaf spot. The insects, being small and very active, are not much in evidence. The spots which they produce differ from fungous spots in being transparent. They attack chiefly the leaves near the tips of the canes.

CANE BLIGHT.

The most destructive disease of currants in the Hudson Valley the past season was a cane blight. The leaves on one or more canes in a hill suddenly wilt and soon thereafter the canes die and become dry. The disease may be confined to a single short branch or it may affect several large canes. The entire hill may eventually succumb, but this rarely happens during the first season of attack. It commenced early in May and continued throughout the whole season, being most active while the fruit was ripening.

We first became acquainted with this cane blight in June, 1896, when specimens of it were sent to us from Marlboro. From these specimens it appeared that the trouble was due to a sterile fungus working in the pith and under the bark. Through the kindness of Mr. S. A. Beach it was learned that Mr. D. G. Fairchild had made a brief study of the same disease in 1891 and had given a talk upon it before the Botanical Club of the American Association for the Advancement of Science at its meeting in Washington in August, 1891. He attributed it to a sterile fungus. A short account of this talk was published in the *Botanical Gazette* for September, 1891, page 262.

Before having an opportunity to study the disease in the field we learned that Dr. E. J. Durand, of Cornell University, was

investigating a currant cane blight having the same symptoms, in Western New York. Upon the appearance of his bulletin[20] in which it was stated that *Nectria cinnabarina* Tode was the cause of the disease, we concluded that the sterile fungus observed by Fairchild and by us was probably only a saprophyte; but our observations during the past season have convinced us that it is really an active parasite. The disease occurs to a greater or less extent throughout the entire Hudson Valley. In many plantations it is very destructive. We have cut open and examined several hundred, perhaps as many as a thousand, of the affected canes, and almost invariably found the sterile fungus in the pith and under the bark. Its presence can generally be determined with the unaided eye and nearly always with the aid of a good hand lens. In a very few cases, perhaps half a dozen, we have found borers; but in no case have we found *Nectria cinnabarina* either in its perithecial or conidial stage. *The currant cane blight occurring in the Hudson Valley is not caused by* Nectria cinnabarina *but by a sterile fungus.*[21]

When a cane of the previous season's growth first shows wilting of the leaves it appears normal externally. But on splitting an affected stem there will usually be found a place near the base of the affected portion, where the bark is dead and the wood and pith dead and discolored for an inch or more. The presence of the fungus is manifested by delicate cobwebby patches of hyphæ in the pith. This is the seat of the trouble, and from it as a center the fungus spreads both ways; upward, so as to frequently occupy the whole wilted branch, and downward so as to kill successively the lower branches of the cane. The disease seems to strangle the canes near the point of infection, killing the portion beyond by cutting off the supply of sap.

In canes of the present season's growth the fungus spreads

[20] A Disease of Current Canes. Cornell Exp. Sta. Bul. 125. F. 1897.

[21] Exact proof by inoculation experiments is lacking. But the large number of cases in which the sterile fungus has been found associated with the disease is considered sufficient proof for this statement.

upward so rapidly that the whole cane is discolored and permeated by the fungus hyphæ throughout its entire length soon after the leaves are wilted. In the pith of such specimens the hyphæ are especially conspicuous.

In the currant cane the hyphæ are white or dirty white, but on bean stem cultures they soon become smoke colored or even black. No spores or other indications of fructification have been observed and nothing is known of the manner in which the fungus is disseminated. It occurs upon both red and white currants, *Ribes rubrum,* and has also been observed in one case upon the black currant, *R. nigrum.*

The diseased canes should be cut out and burned. In doing this care should be taken to cut well below the lowest point of the disease; otherwise the labor is wasted. Also, the pruning knife should be frequently dipped into some disinfecting solution; for example, a 5 per ct. solution of carbolic acid. If this is not done pruning may serve to spread the disease instead of checking it.

It is hoped that a thorough study of this disease may be made in the near future.

DEWBERRY DISEASES.

There are probably other commercial plantations of dewberries in the Hudson Valley, but we have made observations upon one only, which was located at Highland in Ulster County. The plants were of the variety Lucretia. They were trained up to stakes, several canes to each stake. During the previous winter they had been allowed to lie upon the ground. In the spring they put out leaves normally, but later a good many of them died. Some were just commencing to wilt at the time of our observations (June 21). It was rare to find all of the canes in a hill dead. Usually, from one to four of the canes were dead and the rest apparently healthy. As a rule the affected canes were green and healthy for a few inches above the soil; then there came a blackened (but not constricted) portion a few inches long, which seemed to be the seat of the trouble. No fungus was

visible upon any of the dead parts and no fungus hyphæ were found in the bark or pith. It is not likely that this was winter injury or the effect of drought. We cannot account for it.

A small amount of leaf spot (*Septoria rubi* Westd.) occurred in this plantation.

GOOSEBERRY DISEASES.

POWDERY MILDEW.[22]

(*Sphaerotheca mors-uvae* (Schw.) B. & C.)

This is the most destructive gooseberry disease. It is reported to have been very bad in Ulster and Columbia counties. One correspondent reports that his Downing gooseberries sprayed four times with Bordeaux mixture were almost free from mildew, while with the variety Industry, given the same treatment, one-half of the crop was ruined. The disease occurred also in Dutchess county.

ROOT ROT.

During the past five years a destructive root rot disease has existed in a gooseberry plantation at Marlboro. It started at one corner of the plantation and gradually spread, killing every plant as far as the disease extended. At the present time the affected area measures about 40 by 50 feet. The plants die gradually, living from one to four years after the appearance of the first symptoms of disease. Dead canes and living ones occur in the same hill, but the leaves on the living canes are more or less dwarfed. Early in May we had the privilege of examining about a dozen of the affected plants which had recently been dug up. Upon the roots of all of them there was a conspicuous white mycelium. It was at once concluded that this fungus was the cause of the trouble, and from the nature of the rhizomorphs referred it provisionally to the form-genus *Dematophora.*

In November the Horticulturist had occasion to remove a lot of seedling gooseberries which had been growing between the rows

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22 For experiments on the treatment of this disease, see Bulletin 161 of this Station.

in one of the Station vineyards for six seasons. Although but few of these plants had been grown thriftily, none of them had shown pronounced symptoms of disease. Accordingly, we were surprised to find the roots of many of them covered with the same fungus which had been found on the diseased gooseberries at Marlboro. The fact that it occurred on apparently healthy plants caused us to doubt the correctness of our former conclusions.

Pieces of the fungus-infested roots were stuck in moist sterilized sand in a Mason fruit jar previously made sterile by a solution of corrosive sublimate. In about six weeks they began to show conidial fructification like that of *Dematophora.*

From diseased grape roots placed in the Mason jar sand cultures we had previously obtained the conidial fructification of a *Dematophora.* (See Grape Root Rot.) The rhizomorphs of the gooseberry fungus were strikingly like those of the grape *Dematophora* except that the hyphæ composing them were slightly smaller. Accordingly, we expected to get the same sort of conidial fructification; but the spores of the gooseberry fungus were larger and the branching of the sporophores different. We believe the gooseberry fungus to be a species of *Dematophora,* but there is some doubt about it being an active parasite.

During the past season the gooseberry disease at Marlboro spread but little owing probably to the dry season. In the wet season of 1898 it made rapid progress. The owner of the diseased gooseberries believes that the plants have died through some evil influence of a large black walnut tree[23] which stands at the corner of the plantation where the disease started; but it is scarcely possible that this can have been the direct cause.

DWARFED FOLIAGE.

In another gooseberry plantation we saw a few plants which appeared healthy, except that all of the leaves were abnormally

[23] For another case of supposed injury by black walnut tree, see Grape Root Rot on pages 297–298.

small. The owner states that in 1898 there had been many plants so affected. The affected plants were intermingled with healthy ones.

GRAPE DISEASES.

BLACK ROT.

(*Laestadia bidwellii* (Ell.) Viala & Ravaz.)

Black rot has been, as usual, the worst grape disease, but was not nearly so destructive as in 1898. The worst case we have seen or heard of this year occurred at West Nyack, Rockland County, where 75 per ct. of the crop was ruined by it. In some vineyards in Westchester County, it is reported to have caused a loss of 50 per ct. From various other localities it is reported destructive in unsprayed vineyards.

Bordeaux mixture, properly applied, is an almost certain preventive of this disease. It should be more generally used in the Hudson Valley.

DOWNY MILDEW.

(*Plasmopara viticola* (B. & C.) Berl. & De Toni.)

This disease appears to have been scarce except in the southern part of the district where it was destructive in a few vineyards. At West Nyack it was severe on several varieties, but showed a decided preference for the variety Delaware.

ROOT ROT.

(*Dematophora necatrix* (?) Hartig.)

While on a visit to Middle Hope we were informed that in a vineyard near that place grape vines had been killed by a black walnut tree. We visited the vineyard and found that the tree, which was of enormous size, stood about 40 feet from the edge of the vineyard. Opposite the tree all of the vines over a small semi-circular area had died. The owner stated that peach trees had been planted in the vacant area but they, too, had died. We dug up some of the dead vines and found the roots covered

with a white mycelium. Pieces of the fungus covered roots were stuck into wet sand in a sterilized Mason fruit jar. In this culture the white mycelium was gradually replaced by numerous light brown rhizomorphs and after three months the roots became thickly covered with the conidial fructification of *Dematophora*. The sporophores measured from one to one and one-half millimeters in height. To the unaided eye they appeared to be short, brown stalks with colorless or purple ovoid knobs on their ends. Under the microscope the brown stalks proved to be compound sporophores, composed of brown, septate hyphæ; and the colorless, ovoid knobs were composed of small, colorless, ovoid spores borne on the branched free ends of these hyphæ. The fungus agreed closely with Hartig's description[24] of *Dematophora necatrix* except that the hyphæ composing the rhizomorphs were destitue of pyriform swellings at the septa.

The *Dematophora*, and not the walnut tree, was probably the cause of the death of the vines. Some of the dead vines were certainly beyond the reach of the roots and shade of the tree. The soil was a sandy loam and well drained. See Gooseberry Root Rot, page 203.

CHLOROSIS, OR YELLOW FOLIAGE.

In an old but well cared for vineyard at Coxsackie we found many plants showing yellow foliage by June 1. The yellow leaves were much dwarfed. Sometimes the whole vine was affected, but it often happened that a part of a vine would be diseased and a part healthy. According to the owner, affected canes die the following winter. When all of the canes are affected and die, new canes come up from the root. The affected plants were scattered irregularly over the vineyard.

Chlorosis may be due to several causes. Not having had oppor-

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[24] Hartig, R. *Dematophora necatrix*, n. sp. Untersuchungen aus d. forstbotan. Institut zu München. III, 1883.

tunity to study this case thoroughly no statement is made as to its cause.

BLACK KNOT.

A considerable number of specimens of this disease were found in an old vineyard at Middle Hope. At a distance of from six inches to two feet above the ground the stems showed warty excrescences of spongy texture. (See Plate XVII.) No knots were found on the roots or at the crown. These excrescences bear a striking resemblance to the black knots on plums and cherries caused by the fungus *Plowrightia morbosa* (Schw.) Sacc., but they have an entirely different origin. European investigators hold that they are due to the action of frost.[25]

The disease appears to be rare in the Hudson Valley, but in Central and Western New York it is met with frequently. It is also reported from Pennsylvania,[26] California[27] and Canada.[28] From American writers on plant diseases it has received very little attention, although it has a considerable literature in French, German and Italian.

PEACH DISEASES.

WINTER INJURY.

The Hudson Valley peach crop of 1899 was almost a complete failure owing to the hard freeze in February which killed nearly all of the fruit buds. There were very few orchards that bore any fruit. In many orchards the twigs also were much injured and in some the trees were killed outright. The severe attack of leaf curl in 1898 probably made the trees unusually susceptible to winter injury.

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25 See Frank, A. B. Die Krankheiten der Pflanzen, 1: 209–210. Breslau, 1895.

26 Galloway, B. T. Botanical Div. U. S. Dept. Agr. Bul. 8: 63.

27 Woodworth, C. W. Cal. Exp. Sta. Bul. 99: 2. This, however, may be a different disease.

28 Fletcher, Jas. Canada Experimental Farms Rept. for 1889: 87.

LEAF CURL.

(*Exoascus deformans* (Berk.) Fckl.)

Leaf curl has given very little trouble. Over the greater part of the district it is reported as occurring only to a slight extent. Correspondents at Stockport, Columbia Co., and Annandale, Ulster Co., report it severe; but it is possible that in these cases the fungous leaf curl may have been confused with the work of plant lice.[29]

It appears that the weather conditions in early spring exert a a marked influence upon leaf curl. In 1898 it was very destructive.

YELLOWS.

This disease is common throughout the Hudson Valley and in some localities very destructive. From year to year it fluctuates somewhat in virulence, but may be depended upon to appear to a considerable extent every season. It is one of the most troublesome peach diseases in this section.

FRUIT ROT.

(*Monilia fructigena* P.)

Usually this disease is common, but in 1899 it was scarce because there was little fruit to rot. It has been reported from Tarrytown, Milton, Ghent, Middle Hope and Washingtonville.

LEAF TIP-BURN.

In a small orchard of young trees at Monsey, Rockland Co., a leaf trouble was observed which may be called tip-burn. The tips and margins of the leaves on the new wood appeared water-soaked[30] and transparent. Upon drying, the diseased portions became yellowish white. The trees were of the variety Red Cheek

29 Some fruit growers know the *Exoascus* disease by the name "red blister," and the work of aphides by the name "leaf curl." This tends to confusion.

30 The water-soaked condition may not be a character of the disease, but due to a rain which occurred a short time before the observations were made.

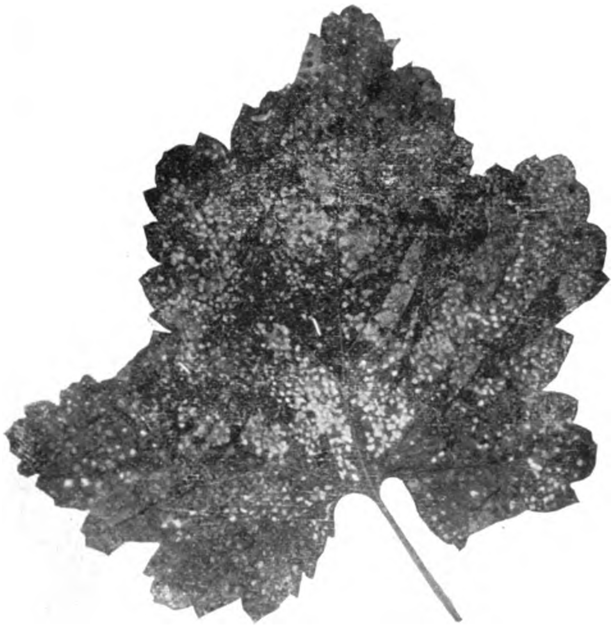

FIG. 1.—CURRANT LEAF INJURED BY FOUR-LINED LEAF BUG.

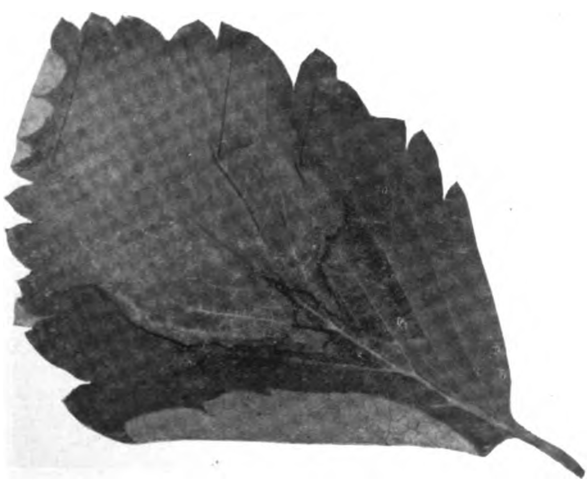

FIG. 2.—STRAWBERRY LEAFLET AFFECTED BY SUN-SCALD.

PLATE XVI.

PLATE XVII.—BLACK KNOT OF THE GRAPE.

PLATE XVII.—BLACK KNOT OF THE GRAPE.

and had suffered severely from leaf curl the previous season. The observations were made on May 24, at which time the tip-burned leaves were abundant. The cause of it is unknown to us, but it is probably not of fungous origin.

POWDERY MILDEW AND SCAB.

Neither powdery mildew nor scab, *Cladosporium carpophilum* Thum, is known to have occurred anywhere in the Hudson Valley during the past season.

PEAR DISEASES.

SCAB.

(*Venturia pirina* Aderh. Syn. *Fusicladium pirinum* (Lib.) Fckl.)

Pears have been remarkably free from scab. Many of our correspondents report none of it; several report "a little;" and a few report its occurrence in considerable quantity. Judging from these reports it appears to have been worst in Columbia Co., but in no case was it so bad as last season.

LEAF BLIGHT AND LEAF SPOT.

(*Entomosporium maculatum* Lev. and *Septoria piricola* Desm.)

Only eight correspondents report the occurrence of pear leaf blight, and none of these report it destructive. Not having succeeded in taking a single specimen ourselves we do not know which of the two diseases was the more common.

FIRE BLIGHT.

(*Bacillus amylovorus* (Burr.) De Toni.)

Although more common than either scab or leaf blight, the fire blight has been destructive in only a few localities.

"BODY BLIGHT" OR ROUGH BARK.

There is a disease of the trunks and larger branches of pear trees commonly known as "body blight." Over areas which are

at first small and more or less circular, but later coalesce into large patches of various shapes, the bark is dead and dry and clings tightly to the wood. By the shrinkage of the bark in drying the affected areas become slightly depressed and bounded by a crack which separates them sharply from the adjacent healthy bark. This gives the affected trunks and branches a rough, cracked, unhealthy appearance. The trees are seldom killed outright, but their growth is checked, often to such an extent as to hopelessly stunt them.

"Body blight" has generally been considered to be a form of the fire blight caused by the microorganism *Bacillus amylovorus;* but according to Paddock[31] it may be caused by the apple canker and black rot fungus, *Sphaeropsis malorum* Pk. It is not our purpose to discuss here the nature of the disease, but to report its common occurrence in the Hudson Valley. In all of the counties within the district excepting Rockland, Putnam and Westchester it was found in great abundance. In a severely attacked orchard in Greene County, portions of several trees appeared to have been killed by it. The branches were thickly covered with the pycnidia of *Sphaeropsis malorum.* A few trees after struggling along in a half dead condition for several years finally died, apparently from *Sphaeropsis.*

WINTER INJURY (?)

In each of several orchards in the vicinity of Athens, Greene County, a few pear trees died mysteriously. They seemed to have died from some cause which killed the bark just below the surface of the soil. The parts above ground appeared normal. To the unaided eye no fungus was present on the roots or on the dead bark of the subterranean portions of the trunk. There were no signs of insects. In all cases the dead trees stood in a heavy clay soil and were scattered irregularly through the orchard among healthy trees.

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31 Paddock, Wendell. The New York Apple-Tree Canker. Bul. 163 of this station, p. 203.

PLUM DISEASES.

BLACK KNOT.

(*Plowrightia morbosa* (Schw.) Sacc.)

About 20 years ago plum growing was an important industry in the Hudson Valley, particularly in Greene Co. About 1884 there was an epidemic of black knot which ruined most of the plum orchards and so discouraged fruit growers that few have had the courage to replant on a large scale. Another, but less destructive epidemic occurred in 1891. At the present time the Japanese plums are being planted quite largely. They are not affected to an injurious extent by the black knot. On the European varieties it is still very troublesome and an epidemic may be expected whenever a favorable season occurs. It has probably spread but little during the past season.

FRUIT ROT.

(*Monilia fructigena* P.)

The Hudson Valley plum grower has another serious enemy in the brown rot of the fruit. In spite of the very dry season this disease has been quite bad in some localities. At Millbrook, Dutchess Co., it is reported to have destroyed two-thirds of the crop; at Old Chatham, Columbia Co., 50 per ct. of the crop; at Annandale, Ulster Co., Newburgh, Orange Co., and at Blauvelt, Rockland Co., 25 per ct. It was also abundant in Westchester Co., and occurred to a considerable extent in Greene and Rensselaer counties.

LEAF BLIGHT OR "SHOT HOLE" DISEASE.

This disease is commonly caused by the fungus *Cylindrosporium padi* Karst., but Duggar[82] has recently shown that it may be produced by Bordeaux mixture, especially if improperly prepared; by other chemicals and even by certain weather conditions.

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82 Duggar, B. M. Peach Leaf-Curl and Notes on the Shot Hole Effect of Peaches and Plums. Cornell Agr. Exp. Sta. Bul. 164. F. 1899.

Leaf blight has been reported from a few localities, but does not appear to have been serious except in a few cases where it was evidently caused by spraying. At Yorktown, Japan plums were observed which were severely "shot holed" by spraying with carefully made dilute Bordeaux mixture.

A correspondent from Stockport, Columbia Co., writes: "The plums, both sprayed and unsprayed, looked well until after the first heavy rain, when, on the trees that had been sprayed, the leaves spotted, turned red and fell off. I think this must have been due to the spray, as the unsprayed trees were not affected." We think that this opinion is correct.

LEAF CURL.

(*Exoascus mirabilis* Atk.)

A few shoots of Wild Goose plum affected with this fungus were observed at Tallman, Rockland Co.

QUINCE DISEASES.

FRUIT SPOT AND LEAF BLIGHT.

(*Entomosporium maculatum* Lev.)

Fruit spot and leaf blight are caused by the same fungus. It is reported to have been abundant in Columbia, Westchester and Orange counties. A correspondent at Ghent dug out all of his bushes because of it. This was quite unnecessary because Bordeaux mixture would have prevented the disease at a very small cost.

FIRE BLIGHT.

(*Bacillus amylovorus* (Burr.) De Toni.)

The fire blight on quince is the same as that occurring on pear and apple. It was reported by three correspondents to have occurred in small quantity.

RASPBERRY DISEASES.

ANTHRACNOSE.

(*Gloeosporium venetum* Speg.)

The replies to our circular letter of inquiry indicate that raspberry anthracnose has been common. Although not so stated, these replies probably relate to anthracnose on last year's canes. Judging from our own observations we believe that canes of the present season's growth have been but slightly affected.

RUST.

(*Puccinia peckiana* Howe. Syn. *Caeoma nitens* Schw.)

Rust has occurred in several plantations, but not to a destructive extent except in a very few cases. Under some conditions rust has a tendency to reduce the number of prickles. For a more detailed discussion of this subject, see Blackberry Rust, page 194.

ROOT GALLS.

We know of but one occurrence of this disease in the Hudson Valley. Others probably exist, however. In April a fruit grower at Madalin, Dutchess County, sent us a red raspberry root bearing several rough, spongy, roundish knots or galls varying from the size of a pea to that of a walnut. The sender wrote that in the spring of 1898 he had purchased 30 Loudon raspberry plants from a Rochester nurseryman. A year later half of them had died from the root galls.

The cause of such root galls is not known. There is some evidence that the disease is communicable from one plant to another, and also from raspberries to peaches and *vice versa*. Plants showing root galls should not be planted, not even after the galls have been removed.

WINTER INJURY.

Red raspberries not laid down were injured by the severe winter. At Poughkeepsie, red raspberries of the variety Marlboro winter-killed nearly to the ground, while Miller's Red in the

same field and under parallel conditions suffered but slightly. In a plantation of red raspberries at Marlboro, canes which passed the winter tied up to stakes were killed back from six to eighteen inches. The injury was worse on low ground.

CANE BLIGHT.

(? *Phoma.*)

In various localities in the northern part of the district there is a common disease of raspberries, which may be called cane blight for want of a better name. On June 1 it was observed at Coxsackie on black raspberries. Its attacks were confined almost exclusively to old canes. The owner states that it rarely attacks young canes, but did so to some extent last season. Some canes were dead, others nearly dead, and still others showing the first symptoms. The affected canes showed a brownish black discoloration of the bark which was dead. Usually the discoloration extended the whole length of the cane on one side only, the bark on the other side remaining alive and green. Numerous pycnidia of at least four different species of fungi were found on the dead bark. The predominating form was a species of *Phoma* having small, round or slightly ellipsoidal spores with a brownish tinge.

At Poughkeepsie on June 20, we found what appeared to be the same disease killing the canes of black raspberries. It was destructive. Canes here and there were dying and their abundant fruit, which was nearly ripe, was drying up. The owner thought it the effect of drought. Here, as at Coxsackie, only the fruiting canes were affected. The affected plantation was an old one. An adjacent plantation of young plants of the same variety was not affected. The tendency of the canes to die on one side was not so pronounced as at Coxsackie, but pycnidia of the same *Phoma* were abundant and occurred so close to the healthy bark as to indicate that the fungus was parasitic.

On July 19 the same disease on black raspberries was found at Voorheesville. Here it had ruined one-third of the crop. It was

in a plantation five years old. The owner states that it occurs chiefly in old plantations, those two and three years old usually being exempt. It is worst on high ground and occurs in wet seasons as well as dry ones. The canes commenced to die about the time the fruit began to ripen. Often the entire cane was affected, but frequently only a part of it. Healthy and diseased branches occurred on the same cane. Sometimes a cane would be dead upon one side and in a semi-living condition upon the other. The pycnidia of the *Phoma* were to be found on almost every affected cane, and where one was killed back only part way the pycnidia would be clustered just above the boundary between the living and the dead tissue.

At Voorheesville the disease was noticed attacking also red raspberries of the variety Cuthbert. Berries, leaves and wood suddenly dried up while the fruit was ripening. Usually, but not always, the whole cane was affected. At some point on the cane there were numerous pycnidia of the same *Phoma* found on black raspberries. When only a portion of a cane was affected the pycnidia were commonly clustered (as on black raspberries) just above the boundary between the diseased and healthy bark. On the red raspberry the pycnidia appear to the unaided eye somewhat different from those on the black raspberry.

A disease having the same symptoms attacks the Marlboro, a red variety extensively planted in the Hudson Valley. On this variety it is especially destructive and is everywhere known as "the Marlboro raspberry disease." A bad case of this was observed at Delmar, but the examination was so hasty that little can be said concerning it. It is certain, however, that the *Phoma* was not so abundant as in the previously mentioned cases. At this place the yellow variety, Golden Queen, was also attacked by it.

At West Sand Lake it was destructive on the variety Shaffer, being worse in the older portions of the plantation. Correspondents report it from various other localities. It is a widespread and destructive disease.

It seems probable that the disease of red raspberries is the same of that of the black varieties. It may, perhaps, be aggravated by drought, but the evidence in hand is opposed to the theory that drought is the sole, or even the principal, cause. In the first place the symptoms are not those of drought. On raspberry canes suffering from drought the foliage becomes yellowish, the berries are abnormally small and the whole plant gradually dries up. All of the fruiting canes in a hill are about equally affected; in fact the whole plantation, if on fairly uniform soil, will be uniformly affected. Whereas, in the disease under discussion, canes die here and there with diseased canes and healthy canes occurring even in the small hill.

We are not prepared to say positively that the *Phoma* found on the affected canes is the cause of the disease because no inoculations with it have been made; but it is certainly to be regarded with suspicion. This disease is a worthy subject of investigation.[83]

LEAF SPOT.

(*Septoria rubi* Westd.)

Rare. Observed only at Poughkeepsie.

STRAWBERRY DISEASES.

DROUGHT.

Strawberries were damaged more by drought than by all diseases combined. The few persons so situated that they could irrigate their strawberries reaped a harvest of profit.

LEAF BLIGHT OR LEAF SPOT.

(*Sphaerella fragariae* (Tul.) Sacc.)

The situation with regard to this disease may be summed up in a phrase used by several of our correspondents; namely: "Severe on some varieties." It has not been nearly so virulent as in

[83] The supposedly bacterial disease of Turner and Marlboro rasperries described by Freda Detmers, in Ohio Agr. Exp. Sta. Bul. 6, p. 128, seems to be different.

1898, but the more susceptible varieties have suffered considerably. It is well known that varieties differ greatly in their susceptibility to leaf blight. At Poughkeepsie the variety Gandy was severely attacked, while the variety Clyde growing in adjacent rows under parallel conditions was almost entirely exempt.

At Ghent we had an opportunity to observe the disastrous effect of leaf blight upon the crop of the following year. A row of Hunn stood beside a row of Parker Earle. In 1898 the Hunn blighted very severely while the Parker Earle was but slightly affected. On June 2, 1899, the Hunn promised a very trifling yield. Many of the plants did not even start in the spring. In marked contrast to the condition of the Hunn, the Parker Earle was making the best showing for a berry crop that we have ever seen.

It may be that some of our correspondents have confused the leaf spot caused by *Sphaerella fragariae* with that caused by *Ascochyta fragariae* Sacc. The two diseases resemble each other considerably, but the *Ascochyta* spots are redder and show minute black pimples at the center. On May 31 we collected fruiting specimens of the *Ascochyta* at Athens, Greene Co., but we do not believe that it was anywhere as abundant as the *Sphaerella*.

SUN-SCALD (?)

On June 2 we observed at Ghent a peculiar disease on the Hunn strawberry. The leaflets showed dead, brown V-shaped areas at their tips (see Plate XVI, fig. 2). These dead areas often extended half way down the midrib. They were generally situated at the tip of the leaflet, but occasionally occurred at the side. The disease occurred only on the Hunn, on which it was common but not destructive. It did not appear to be due to fungi and certainly not to insects. We are at a loss to account for it unless it may possibly have been a case of sun-scald.

REPORT

OF THE

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Assistant Chemists.

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E. B. Hart,* B. S.
Chas. W. Mudge, B. S.

Table of Contents.

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* Connected with Fertilizer-Control.

REPORT OF THE CHEMIST.

I. REPORT OF ANALYSES OF COMMERCIAL FERTILIZERS FOR SPRING OF 1899.*

L. L. VAN SLYKE.

SUMMARY.

(1) Samples Collected. During the spring of 1899, the Station collected 866 samples of commercial fertilizers, representing 646 different brands. Of these different brands, 482 were complete fertilizers; of the others, 70 contained phosphoric acid and potash without nitrogen; 36 contained nitrogen and phosphoric acid without potash; 7 contained nitrogen only; 37 contained phosphoric acid alone; and 14 contained potash salts only.

(2) Nitrogen. The 482 brands of complete fertilizers contained nitrogen, varying in amount from 0.37 to 8.50 per ct., and averaging 2.04 per ct. The average amount of nitrogen found by the Station analysis exceeded the average guaranteed amount by 0.15 per ct., the guaranteed average being 1.89 per ct. and the average found being 2.04 per ct.

In 371 brands of complete fertilizers, the amount of nitrogen found was equal to or above the guaranteed amount, the excess varying from 0.01 to 2.27 per ct., and averaging 0.28 per ct.

In 111 brands the nitrogen was below the guaranteed amount, the deficiency varying from 0.01 to 1.78 per ct., and averaging 0.19 per ct. In 103 cases, the deficiency was less than 0.5 per ct.

The amount of water-soluble nitrogen varied from 0 to 4.43 per ct. and averaged 0.80 per ct.

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* Partial reprint of Bulletin No. 160.

(3) Available Phosphoric Acid. The 482 brands of complete fertilizers contained available phosphoric acid varying in amount from 1.20 to 15.12 per ct. and averaging 8.76 per ct. The average amount of available phosphoric acid found by the Station analysis exceeded the average guaranteed amount by 0.98 per ct., the guaranteed average being 7.78 per ct. and the average found being 8.76 per ct.

In 418 brands of complete fertilizers, the amount of available phosphoric acid found was equal to or above the amount guaranteed, the excess varying from 0.03 to 6.32 per ct. and averaging 1.23 per ct.

In 64 brands, the available phosphoric acid was below the guaranteed amount, the deficiency varying from 0.02 to 3.68 per ct. and averaging 0.46 per ct. In 44 cases the deficiency was below 0.5 per ct.

The amount of water-soluble phosphoric acid varied from 0 to 10.28 per ct. and averaged 5.40 per ct.

(4) Potash. The complete fertilizers contained potash varying in amount from 0.43 to 12.95 per ct. and averaging 4.86 per ct. The average amount of potash found by the Station analysis exceeded the average guaranteed amount by 0.30 per ct., the guaranteed average being 4.56 per ct. and the average found being 4.86 per ct.

In 331 brands of complete fertilizers, the amount of potash found was equal to or above the guaranteed amount, the excess varying from 0.01 to 3.07 per ct. and averaging 0.59 per ct.

In 151 brands, the potash was below the guaranteed amount, the deficiency varying from 0.01 to 4.36 per ct. and averaging 0.50 per ct. In 105 of these cases, the deficiency was less than 0.5 per ct.

In 85 cases among the 482 brands of complete fertilizers the potash was contained in the form of sulphate free from an excess of chlorides.

(5) The retail selling price of the complete fertilizers varied from $17 to $45 a ton and averaged $26.66. The retail cost of

the separate ingredients, unmixed, averaged $18.28, or $8.38 less than the selling price.

INTRODUCTION.

NUMBER AND KINDS OF FERTILIZERS COLLECTED.

During the spring of 1899, the Station's collecting agents visited 165 towns between March 28 and June 29, obtaining 866 samples of commercial fertilizers. These samples represent 646 different brands, the product of 114 different manufacturers, each manufacturer being represented by from 1 to 39 brands.

The subjoined tabulated statement indicates the different classes included in the collection:

CLASSES OF FERTILIZERS COLLECTED.

Brands containing only nitrogen.	Brands containing only phosphoric acid.	Brands containing only potash.	Brands containing nitrogen and phosphoric acid without potash	Brands containing phosphoric acid and potash without nitrogen.	Brands of complete fertilizers.
7	37	14	36	70	482

COMPOSITION OF FERTILIZERS COLLECTED.

The following tabulated statement shows the average composition of the complete fertilizers collected during the spring, together with a comparison of the guaranteed composition and that found by analysis:

AVERAGE COMPOSITION OF COMPLETE FERTILIZERS COLLECTED.

	Per cent guaranteed.			Per cent found.			Average per ct. found above guarantee.
	Lowest.	Highest.	Average	Lowest.	Highest.	Average.	
Nitrogen	0.39	8.25	1.89	0.37	8.50	2.04	0.15
Available phosphoric acid	1.93	14.00	7.78	1.20	15.12	8.76	0.98
Insoluble phosphoric acid	....	.....	....	0.13	10.80	2.22	....
Potash	0.75	15.00	4.56	0.43	12.95	4.86	0.30
Water-soluble nitrogen	....	.....	....	0.00	4.43	0.80	....
Water-soluble phosphoric acid	....	.....	....	0.00	10.28	5.40	....

TRADE VALUES OF PLANT-FOOD ELEMENTS IN RAW MATERIALS AND CHEMICALS.

The trade values in the following schedule have been agreed upon by the Experiment Stations of Massachusetts, Rhode Island, Connecticut, New York, New Jersey and Vermont, as a result of study of the prices actually prevailing in the large markets of these states.

These trade values represent, as nearly as can be estimated, the average prices at which, during the six months preceding March, the respective ingredients, *in the form of unmixed raw materials,* could be bought at retail for cash in our large markets. These prices also correspond (except in case of available phosphoric acid) to the average wholesale prices for the six months preceding March plus about 20 per ct. in case of goods for which there are wholesale quotations.

TRADE VALUES OF PLANT-FOOD ELEMENTS IN RAW MATERIALS AND CHEMICALS.

	1899. Cts. per pound.
Nitrogen in ammonia salts	15
Nitrogen in nitrates	12½
Organic nitrogen in dry and fine-ground fish, meat and blood, and mixed fertilizers	14
Organic nitrogen in cotton-seed meal and castor-pomace	12
Organic nitrogen in fine-ground bone and tankage	14
Organic nitrogen in coarse bone and tankage	10
Phosphoric acid, water-soluble	4½
Phosphoric acid, citrate-soluble	4
Phosphoric acid in fine-ground fish, bone and tankage	4
Phosphoric acid in coarse fish, bone and tankage	2
Phosphoric acid in cotton-seed meal, castor-pomace and wood ashes	4
Phosphoric acid in mixed fertilizers, insoluble in ammonium citrate and water	2
Potash as high-grade sulphate, in forms free from muriates (chlorides), in ashes, etc.	5
Potash in muriate	4¼

COMPARISON OF SELLING PRICE AND COMMERCIAL VALUATION.

Giving to the different constituents the values assigned in the schedule for mixed fertilizers, 14 cents a pound for nitrogen, 4½

cents a pound for water-soluble phosphoric acid, 4 cents a pound for citrate-soluble phosphoric acid, 2 cents a pound for insoluble phosphoric acid, and 4½ cents a pound for potash, we can calculate the commercial valuation, or the price at which the separate unmixed materials contained in one ton of fertilizer, having the composition indicated in the preceding table, could be purchased for cash at retail at the seaboard. Knowing the retail prices at which these goods were offered for sale, we can also readily estimate the difference between the actual selling price of the mixed goods and the retail cash cost of the unmixed materials; the difference covers the cost of mixing, freight, profits, etc. We present these data in the following tables:

COMMERCIAL VALUATION AND SELLING PRICE OF COMPLETE FERTILIZERS.

Commercial valuation of complete fertilizers.	Selling price of one ton of complete fertilizer.			Averaged increased cost of mixed materials over unmixed materials for one ton.
Average.	Lowest.	Highest.	Average.	
$18.28	$17	$45	$26.66	$8.38

COST OF ONE POUND OF PLANT FOOD IN FERTILIZERS AS PURCHASED BY CONSUMERS.

In the table below we present figures showing the average cost to the purchaser of one pound of plant-food in different forms in mixed fertilizers:

AVERAGE COST OF ONE POUND OF PLANT-FOOD TO CONSUMERS IN MIXED FERTILIZERS.

Nitrogen	20.4 cents.
Phosphoric acid (available)	6.2 cents.
Potash	6.2 cents.

NEW FERTILIZER LAW.

The last State legislature amended the fertilizer law and attention is called to the principal changes that affect manufacturers and dealers.

(1) All fertilizers selling for *five* dollars or more per ton will come under the law, the limit previously having been confined to fertilizers selling for *ten* dollars or more per ton.

(2) Every manufacturer, importer, dealer or agent must pay a license fee amounting to *twenty* dollars a year for each separate brand or kind of fertilizer or fertilizing material.

(3) Statements of guarantee analysis, etc., are to be filed and license fees paid *during December* each year, covering the goods to be sold during the year following.

LAWS OF NEW YORK.

CHAPTER 955, LAWS OF 1896, AS AMENDED BY CHAPTER 687, LAWS OF 1899.

[Law is given as amended — changes in italics.]

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Statement of amount, brand name, manufacturer's name and address, and chemical composition required on each package.

Section 1. Every person who shall sell, offer or expose for sale in this State any commercial fertilizer or any material to be used as a fertilizer, the selling price of which exceeds *five* dollars per ton, shall stamp on or affix to each package of such fertilizer, in a conspicuous place on the outside thereof, a plainly printed statement which shall certify as follows:

1. The number of net pounds of fertilizer in the package sold or offered for sale;

2. The name, brand or trade-mark under which the fertilizer is sold;

3. The name and address of the manufacturer of the fertilizer;

4. The chemical composition of the fertilizer expressed in the following terms:

(a) Per centum of nitrogen;

(b) Per centum of available phosphoric acid, or in case of undissolved bone, the per centum of total phosphoric acid;

(c) Per centum of potash soluble in distilled water.

If any such fertilizer be sold, offered or exposed for sale in bulk, such printed statement shall accompany every part and parcel so sold, offered or exposed for sale.

Falsity in statement and deficiency in percentage composition violate provisions of act.

§ 2. It shall be a violation of the provision of this act if the statement required by section one of this act shall be false in regard to the number of net pounds of fertilizer in the package sold, offered or exposed for sale, or in the name, brand or trade-mark under which the fertilizer is sold, or in the name and address of the manufacturer of the fertilizer. It shall also be a violation of the provisions of this act if any commercial fertilizer or material to be used as a fertilizer shall contain a smaller percentage of nitrogen, phosphoric acid or potash than is certified in said statement to be contained therein, when such deficiency shall be greater than one-third of one per centum of nitrogen, or one-half of one per centum of available phosphoric acid (or one per centum of total phosphoric acid in the case of undissolved bone), or one-half of one per centum of potash soluble in distilled water.

Filing of statement required; license fee of twenty dollars per brand required; certificate given; fees go to treasurer of State; report of expenditures for analytical work required.

§ 3. Before any commercial fertilizer or any material to be used as a fertilizer is sold, offered or exposed for sale in this state, the manufacturer, importer or person who causes the same to be sold, offered or exposed for sale shall file with the New York Agricultural Experiment Station at Geneva, a certified copy of the statement prescribed in section one of this act, and, in addition, such

statement shall be filed thereafter annually during the month of *December. Each manufacturer, importer or person, before selling, offering or exposing for sale in this state any brand of commercial fertilizer, shall annually, during the month of December, pay to the treasurer of the New York Agricultural Experiment Station a license fee of twenty dollars for each and every brand of fertilizer, bearing a distinctive name, brand or trade mark, which said manufacturer, importer or person is to sell, offer or expose for sale in this state during the calendar year next succeeding said payment, provided, always, that the placing of any new brand upon the market at any time during said calendar year shall be preceded by such payment. Each manufacturer, importer or person who has complied with the provisions of this act relative to filing the aforesaid certified statement and to the payment of the aforesaid license fee shall be entitled to receive a certificate from the director of said station setting forth said facts. Said treasurer shall pay all money received as aforesaid to the treasurer of the state of New York, which treasurer when said money is so appropriated, upon the audit of the board of control of said station and the order of the comptroller of the state of New York, shall pay the money so received, or so much of it as may be necessary, in maintaining the expenses of enforcing the provision of this act. Said board of control shall report annually the expenditures so incurred for salaries, laboratory expenses, chemical supplies, traveling expenses and printing.*

Presence of inert nitrogenous matter to be stated.

§ 4. No person shall sell, offer or expose for sale in this state leather or its products or other inert nitrogenous material in any form, as a fertilizer or as an ingredient of any fertilizer, unless an explicit printed statement of the fact shall be conspicuously affixed to every package of such fertilizer, and shall accompany every parcel or lot of the same.

Penalty for violation.

§ 5. Every person violating any of the provisions of this act shall forfeit and pay to the people of the state of New York the sum of one hundred dollars for every such violation.

Evidence, official.

§ 6. Every certificate duly signed and acknowledged of a chemist or other expert employed by the director of the New York Agricultural Experiment Station at Geneva relating to the analysis of any commercial fertilizer, or material to be used as a fertilizer, shall be presumptive evidence of the facts therein stated.

Prima facie evidence.

§ 7. The doing of anything prohibited by this act shall be evidence of the violation of the provisions of this act relating to the things so prohibited and the omission to do anything directed to be done shall be evidence of a violation of the provisions of this act relative to the things so directed to be done.

Director responsible for enforcement of provisions of act; prosecutions to be brought by attorney-general.

§ 8. The director of the New York Agricultural Experiment Station at Geneva is charged with the enforcement of the provisions of this act, and for this purpose, may employ agents, chemists and experts, and whenever he shall know or have reason to believe that any penalty has been incurred by any person for the violation of any of the provisions of this act, or that any sum has been forfeited by reason of any such violation, he shall report the said violation with a statement of the facts to the attorney-general, who pursuant to the provisions of chapter eight hundred and twenty-one of the laws of eighteen hundred and ninety-five may cause an action or proceeding to be brought in the name of the people for the recovery of the same.

Previous law repealed.

§ 9. Chapter four hundred and thirty-seven of the laws of eighteen hundred and ninety and chapter six hundred and one of the laws of eighteen hundred and ninety-four are hereby repealed.

Act in operation.

§ 10. This act shall take effect immediately.

[The detailed analyses of the samples collected are not reprinted in this report, as they cease to have value before the report is printed and distributed. — Director.]

REPORT OF ANALYSES OF COMMERCIAL FERTILIZERS FOR THE FALL OF 1899.*

L. L. Van Slyke.

SUMMARY.

(1) *Samples Collected.*— During the fall of 1899, the Station collected 138 samples of commercial fertilizers, representing 130 different brands. Of these different brands 101 were complete fertilizers; of the others, 15 contained phosphoric acid and potash without nitrogen; 3 contained nitrogen and phosphoric acid without potash; and 10 contained phosphoric acid alone.

(2) *Nitrogen.*— The 101 brands of complete fertilizers contained nitrogen varying in amount from 0.59 to 4.91 per ct. and averaging 1.65 per ct. The average amount of nitrogen found by the Station analysis exceeded the average guaranteed amount by 0.13 per ct., the guaranteed average being 1.52 per ct. and the average found being 1.65 per ct.

In 79 brands of complete fertilizers, the amount of nitrogen found was equal to or above the guaranteed amount, the excess varying from 0.01 to 1.35 per ct. and averaging 0.23 per ct.

In 22 brands, the nitrogen was below the guaranteed amount, the deficiency varying from 0.03 to 0.62 per ct. and averaging 0.21 per ct. In 18 cases, the deficiency was less than 0.5 per ct.

The amount of water-soluble nitrogen varied from 0.03 to 4.79 per ct. and averaged 0.62 per ct.

* Partial reprint of Bulletin No. 173.

(3) *Available Phosphoric Acid.*— The 101 brands of complete fertilizers contained available phosphoric acid varying in amount from 3.44 to 13.08 per ct. and averaging 9.04 per ct. The average amount of available phosphoric acid found by the Station analysis exceeded the average guaranteed amount by 0.74 per ct., the guaranteed average being 8.30 per ct. and the average found being 9.04 per ct.

In 87 brands of complete fertilizers, the amount of available phosphoric acid found was above the amount guaranteed, the excess varying from 0.03 to 3.28 per ct. and averaging 0.93 per ct.

In 14 brands, the available phosphoric acid was below the guaranteed amount, the deficiency varying from 0.04 to 2.64 per ct. and averaging 0.49 per ct. In 10 cases the deficiency was below 0.05 per ct.

The amount of water-soluble phosphoric acid varied from 0.40 to 10.80 per ct. and averaged 6.07 per ct.

(4) *Potash.*— The complete fertilizers contained potash varying in amount from 0.48 to 10.75 per ct. and averaging 4.30 per ct. The average amount of potash found by the Station analysis exceeded the average guaranteed amount by 0.22 per ct., the guaranteed average being 4.08 per ct. and the average found being 4.30 per ct.

In 74 brands of complete fertilizers, the amount of potash found was above the guaranteed amount, the excess varying from 0.01 to 2.75 per ct. and averaging 0.54 per ct.

In 27 brands, the potash was below the guaranteed amount, the deficiency varying from 0.01 to 3.72 per ct. and averaging 0.65 per ct. In 15 of these cases the deficiency was less than 0.5 per ct.

In 15 cases among the 101 brands of complete fertilizers the potash was contained in the form of sulphate free from an excess of chlorides.

(5) The retail selling prices of the complete fertilizers varied from \$16.50 to \$35.00 a ton and averaged \$23.25. The retail

cost of the separate ingredients unmixed averaged $17.00, or $6.25 less than the selling price.

INTRODUCTION.

NUMBER AND KINDS OF FERTILIZERS COLLECTED.

During the spring and fall of 1899, the Station's collecting agents visited 210 towns, obtaining 1004 samples of commercial fertilizers. These samples represent 776 different brands, the product of 132 different manufacturers, each manufacturer being represented by from one to 39 brands.

The subjoined tabulated statement indicates the different classes included in the collection.

CLASSES OF FERTILIZERS COLLECTED IN 1899.

1899	Brands containing only nitrogen.	Brands containing only phosphoric acid.	Brands containing only potash.	Brands containing nitrogen and phosphoric acid without potash.	Brands containing potash and phosphoric acid without nitrogen.	Brands of complete commercial fertilizers.
Spring collection	7	37	14	36	70	482
Fall collection	0	10	1	3	15	101
Total for year	7	47	15	39	85	583

COMPOSITION OF FERTILIZERS COLLECTED IN 1899.

The tabulated statement below shows the average composition of the complete fertilizers collected during the year, together with a comparison of the guaranteed composition and that found by analysis.

AVERAGE COMPOSITION OF COMPLETE FERTILIZERS COLLECTED.

1899	Per ct. guaranteed. Lowest.	Highest.	Average.	Per ct. found. Lowest.	Highest.	Average.	Average per cent. found above guarantee.
Spring:							
Nitrogen	0.39	8.25	1.89	0.37	8.50	2.04	0.15
Available phosphoric acid	1.93	14.00	7.78	1.20	15.12	8.76	0.98
Insoluble phosphoric acid	....	.....	....	0.13	10.80	2.22	....
Potash	0.75	15.00	4.56	0.43	12.95	4.86	0.30
Water-soluble phosphoric acid	....	.....	....	0.00	4.43	5.40	....
Water-soluble nitrogen	....	.....	....	0.00	10.28	0.80	....
Fall:							
Nitrogen	0.41	4.95	1.52	0.59	4.91	1.65	0.13
Available phosphoric acid	3.55	11.00	8.30	3.44	13.08	9.04	0.74
Insoluble phosphoric acid	....	.....	....	0.63	9.64	2.24	....
Potash	1.00	10.00	4.08	0.48	10.75	4.30	0.22
Water-soluble phosphoric acid	....	.....	....	0.40	10.80	6.07	....
Water-soluble nitrogen	....	.....	....	0.03	4.79	0.62	....
Average for year:							
Nitrogen	....	.....	1.83	....	.....	1.97	0.14
Available phosphoric acid	....	.....	7.87	....	.....	8.80	0.93
Insoluble phosphoric acid	....	.....	....	....	.....	2.23	....
Potash	....	.....	4.48	....	.....	4.76	0.28
Water-soluble phosphoric acid	....	.....	....	....	.....	5.55	....
Water-soluble nitrogen	....	.....	....	....	.....	0.75	....

TRADE-VALUES OF PLANT-FOOD ELEMENTS IN RAW MATERIALS AND CHEMICALS.

The trade-values in the following schedule have been agreed upon by the Experiment Stations of Massachusetts, Rhode Island, Connecticut, New York, New Jersey and Vermont, as a result of study of the prices actually prevailing in the large markets of these states.

These trade-values represent, as nearly as can be estimated, the average prices at which, during the six months preceding March, the respective ingredients, *in the form of unmixed raw materials,*

could be bought at retail for cash in our large markets. These prices also correspond (except in case of available phosphoric acid) to the average wholesale prices for the six months preceding March plus about 20 per ct. in case of goods for which there are wholesale quotations.

TRADE VALUES OF PLANT-FOOD ELEMENTS IN RAW MATERIALS AND CHEMICALS.

	1899. Cents per pound.
Nitrogen in ammonia salts	15
Nitrogen in nitrates	12½
Organic nitrogen in dry and fine-ground fish, meat and blood, and mixed fertilizers	14
Organic nitrogen in cotton-seed meal and castor-pomace	12
Organic nitrogen in fine-ground bone and tankage	14
Organic nitrogen in coarse bone and tankage	10
Phosphoric acid, water-soluble	4½
Phosphoric acid, citrate-soluble	4
Phosphoric acid in fine-ground fish, bone and tankage	4
Phosphoric acid in coarse fish, bone and tankage	2
Phosphoric acid in cotton-seed meal, castor-pomace and wood ashes	4
Phosphoric acid in mixed fertilizers, insoluble in ammonium citrate and water	2
Potash as high-grade sulphate, in forms free from muriates (chlorides), in ashes, etc.	5
Potash in muriate	4¼

COMPARISON OF SELLING PRICE AND COMMERCIAL VALUATION.

Giving to the different constituents the values assigned in the schedule for mixed fertilizers, 14 cents a pound for nitrogen, 4½ cents a pound for water-soluble phosphoric acid, 4 cents a pound for citrate-soluble phosphoric acid, 2 cents a pound for insoluble phosphoric acid, and 4¼ cents a pound for potash, we can calculate the commercial valuation, or the price at which the separate unmixed materials contained in one ton of fertilizer, having the composition indicated in the preceding table, could be purchased for cash at retail at the seaboard. Knowing the retail prices at which these goods were offered for sale, we can also readily estimate the difference between the actual selling price of

the mixed goods and the retail cash cost of the unmixed materials; the difference covers the cost of mixing, freight, profits, etc. We present these data in the following tables:

COMMERCIAL VALUATION AND SELLING PRICE OF COMPLETE FERTILIZERS.

1899.	Commercial valuation of complete fertilizers.	Selling price of one ton of complete fertilizer.			Average increased cost of mixed materials over unmixed materials for one ton.
	Average.	Lowest.	Highest.	Average.	
Spring	$18.28	$17.00	$45.00	$26.66	$8.38
Fall	17.00	16.50	35.00	23.25	6.25
Average for year	$18.06	$16.50	$45.00	$26.07	$8.01

COST OF ONE POUND OF PLANT FOOD IN FERTILIZERS AS PURCHASED BY CONSUMERS.

In the table below we present figures showing the average cost to the purchaser of one pound of plant-food in different forms in mixed fertilizers.

AVERAGE COST OF PLANT FOOD IN MIXED FERTILIZERS AS PURCHASED BY CONSUMERS.

1899.	One pound of nitrogen.	One pound of available phosphoric acid.	One pound of potash.
Spring	20.4	6.2	6.2
Fall	19.2	5.8	5.8
Average for year	20.2	6.1	6.1

[The detailed analyses of the samples collected are not reprinted in this report, as they cease to have value before the report is printed and distributed. — Director.]

REPORT OF ANALYSES OF PARIS GREEN AND OTHER INSECTICIDES.*

L. L. VAN SLYKE.

SUMMARY.

In accordance with the provisions of a law designed to protect purchasers of Paris green, samples were secured during 1899 and the results are published in this bulletin.

Paris green contains as its chief constituent a compound called copper aceto-arsenite, which, when chemically pure, contains

Arsenious oxide	58.64	per ct.
Copper oxide	31.30	"
Acetic acid	10.06	"

In the 24 samples of Paris green examined, the arsenious oxide varied from 55.34 to 60.16 per ct. and averaged 56.48 per ct. The copper oxide varied from 27.70 to 30.90 per ct., and averaged 29.97 per ct. The amount of arsenious oxide for each pound of copper oxide varied from 1.82 to 2.17 and averaged 1.88 pounds. The only adulterant that could be found was white arsenic and this was excessive in only one sample. The general result of the examination is to show a good quality of Paris green in the market at the time the samples were taken.

Partial analyses are given of the following materials: Paragrene, Black Death, Slug Shot, London Purple, Laurel Green, Smith's Electric Vermin Exterminator, Bug Death.

INTRODUCTION.

During the past ten years the use of Paris green has very rapidly increased, owing to its efficiency as an insecticide. There

* Reprint of Bulletin No. 165.

have been frequent complaints on the part of farmers that Paris green has proved inefficient in so many instances as to lead to serious suspicions in regard to its purity. As a result of such complaints, the State legislature, in March, 1898, passed a law intended to prevent fraud in the sale of Paris green; but no appropriation was made for the enforcement of the provisions of the law and no work was done until 1899.

During 1899 samples of Paris green were collected and the results of analysis of these samples are presented in this bulletin. Some materials were collected which were found in the market as insecticides, but which contained little or no Paris green. A general statement of the composition of these will also be given, as information of this kind is often desired.

CHEMICAL COMPOSITION OF PARIS GREEN.

There is more or less confusion as to the exact chemical compound that goes under the name of Paris green. Many chemical writers include two different arsenic compounds under this name, but the compound most frequently met in commerce contains *copper, arsenic* and *acetic acid,* and is chemically known as *copper aceto-arsenite;* in the trade this compound, in a form not chemically pure, is known as Paris green, Schweinfurt green, Imperial green, French green, Emerald green, etc.

Paris green, or copper aceto-arsenite, when chemically pure, contains the following amounts of the different elements indicated:

Arsenic	44.44	per ct.
Copper	24.99	"
Oxygen	25.25	"
Carbon	4.73	"
Hydrogen	0.59	"

Paris green may be regarded as approximately consisting of —

Copper arsenite	82	per ct.
Copper acetate	18	"

However, it is customary, in speaking of the amount of arsenic contained in Paris green, to refer to it as *arsenious oxide;* and, using this form of expression, we would give the composition of pure copper aceto-arsenite as follows:

Arsenious oxide	58.64	per ct.
Copper oxide	31.30	"
Acetic acid	10.06	"

Paris green, as found in commerce, rarely, if ever, consists of pure copper aceto-arsenite, but contains this compound as its chief constituent with varying proportions of other substances.

In the compound copper aceto-arsenite, there are, for each pound of copper oxide, 1.87 pounds of arsenious oxide.

ANALYSES OF SAMPLES OF PARIS GREEN.

Sample number.	Name of Manufacturer.	Brand or trade name.	Place where sample was taken.	Arsenious oxide.	Copper oxide.
22	Adler Color and Chemical Works, 100 William street, New York city	Paris green	West Valley	56.02	29.35
12	Do.	Paris green	Angelica	55.34	28.55
1*	A. B. Ansbacher & Co., 4 Murray street, New York city	Paris green	Holcomb	56.55	30.54
30	Do.	Paris green	Rochester	55.89	30.35
8*	P. Becker & Co., Buffalo, N. Y.	Paris green	Black Creek	56.15	30.45
21*	O. W. Clark & Son, Buffalo, N. Y.	Paris green	East Aurora	56.65	29.90
4*	F. W. Devoe & C. T. Reynolds Co., corner Fulton and William streets, New York city	Paris green	Holcomb	56.65	30.44
11*	Do.	Paris green	Angelica	56.15	30.40
3	Hamden Paint and Chemical Co., Springfield, Mass.	Paris green	Holcomb	57.03	30.06
27	Do.	Paris green	Jamestown	56.15	30.75
14	Morris Hermann & Co., 255 Pearl street, New York city	Paris green	Friendship	60.16	27.70
31*	Highlands Chemical Co., 100 William street, New York city	Paris green	Friendship	56.15	28.95
15*	Fred L. Lavanburg, 165 William street, New York city	Paris green	Rochester	56.55	29.80
18*	Geo. E. Lavereck, Buffalo, N. Y.	Paris green	Franklinville	56.28	29.95
6*	Leggett & Brother, 30 Pearl street, New York city	Paris green	Canandaigua	56.55	29.75
20	Do.	Paris green	Rochester	56.15	30.10
10	Lewis Berger & Sons, 248 Front street, New York city	Paris green	Black Creek	58.15	28.90

24*	Maltby Chemical Co., Buffalo, N. Y.	Paris green	Cattaraugus	56.28	30.90
23*	I. Pfeiffer, 174 Fulton street, New York city	Paris green	Little Valley	55.89	30.55
5	Sondheim, Alsberg & Co., New York city	Paris green	Canandaigua	56.16	29.81
2*	Not given	Paris green	Holcomb	56.31	30.35
9*	Not given	Paris green	Black Creek	56.15	30.55
13*	Not given	Paris green	Friendship	56.65	30.65
16*	Not given	Paris green	Friendship	55.58	30.50

* Dissolved completely and easily in strong ammonia.

DISCUSSION OF RESULTS OF ANALYSIS.

1. In the 24 samples of Paris green examined, the amount of arsenious oxide varied from 55.34 to 60.16 per ct. and averaged 56.48 per ct. This average is only about 2 per ct. below the arsenious oxide contained in pure copper aceto-arsenite and indicates a good quality of Paris green, so far as the arsenic content is concerned. Excepting one or two samples that run high in arsenic, the variation is surprisingly small. The legal requirement is 50 per ct. arsenious oxide.

2. The amount of copper oxide varies from 27.70 to 30.90 per ct. and averages 29.97 per ct., which is one and one-third per ct. below that in pure copper aceto-arsenite. The copper content therefore indicates a good quality of Paris green.

3. In pure copper aceto-arsenite there are 1.87 pounds of arsenious oxide for one pound of copper oxide. Now, this relation is of value in showing whether Paris green contains more arsenious oxide than it ought. The chief adulterant used in Paris green is arsenious oxide, commercially known as white arsenic. This is used because it is cheaper than Paris green and also because it can be safely added without any danger of reducing the amount of arsenious oxide. In fact, a very poor quality of Paris green can be brought up to the legal requirements by addition of arsenious oxide. However, arsenious oxide cannot be added to Paris green without increasing the ratio of arsenious oxide to copper oxide above 1.87. In the samples examined, the ratio of arsenious oxide to copper oxide varies from 1.82 to 2.17 and averages 1.88. In sample No. 14, the arsenious oxide exceeds 60 per ct. and the copper is less than 28 per ct.; hence, the arsenious oxide is present in amounts more than twice exceeding the copper oxide. In other words, there is too much arsenious oxide for the copper oxide present and the only possible inference is that white arsenic has either been added purposely or is present as the result of carelessness in manufacture.

4. The solubility of Paris green in strong ammonia is a fair test of purity, so far as concerns the addition of white arsenic and insoluble adulterants, like barium sulphate, calcium sulphate, etc. In the table above we have indicated those samples that dissolved easily and completely in strong ammonia, making a perfectly clear solution without sediment. These samples were free from white arsenic. Fifteen samples dissolved satisfactorily, while nine samples did not dissolve completely at once, but only on standing for a considerable time, and even then traces remained undissolved.

5. In general, it may be said that the results of our work indicate a very satisfactory condition as to the purity of the Paris green in the market. They do not justify the widespread belief that Paris green is extensively and seriously adulterated. In every instance the arsenious oxide considerably exceeds the legal requirements. The only material that we have found used as an adulterant is white arsenic and this in only one or two cases. In not a single case have we found such materials as sulphates of barium, calcium, etc.

6. The color of Paris green is changed to such an extent by addition of white arsenic or other similar materials that one can usually detect an adulterated article by its appearance. Paris green of good quality is intensely bright green and uniform. When adulterated, the green loses something of its intensity and is grayish green and is not always uniform.

EXAMINATION OF MISCELLANEOUS INSECTICIDES.

PARAGRENE.

Two samples of this material were secured, one at Jamestown and one at Geneva. One sample contained 43.34 per ct. arsenious oxide and 18.08 per ct. copper oxide; and the other 52.30 per ct. arsenious oxide and 21.64 per ct. copper oxide. The arsenic is present in combination with calcium as calcium arsenite to some extent. The material is a proprietary article and is not put on the market as a Paris green. From the results obtained

with the two samples examined, it appears to be very variable in composition. Paragrene is manufactured by Fred L. Lavanburg, 165 William St., N. Y. City.

BLACK DEATH.

This material is made by the Oatka Chemical Co., Mumford, N. Y. The sample examined was obtained at Canandaigua. It consists largely of sulphate of lime or gypsum. It contains a very small amount of arsenic and some organic matter not determined.

SLUG SHOT.

This is manufactured by Benjamin Hammond, Fishkill-on-Hudson, N. Y. The sample examined was secured at Cuba. The material is largely sulphate of lime and silica, with small amounts of copper and arsenic compounds.

LONDON PURPLE.

London purple is a by-product in manufacture of dyes. It is very variable in composition. The arsenic is present chiefly as a calcium arsenite. The sample examined was found at East Aurora, and came from Hemmingway's London Purple Co., London and New York. It contained 32.88 per ct. arsenious oxide.

LAUREL GREEN.

This is made by the Nichols Chemical Co., New York, and the sample examined was found at East Aurora. It was found to contain 3.83 per ct. arsenious oxide and 11.50 per ct. copper oxide with large amounts of calcium carbonate and calcium hydoxide (slaked lime).

SMITH'S ELECTRIC VERMIN EXTERMINATOR.

This is made by Fernando B. Smith, Canton, O. The sample was taken at Jamestown. It appears to be mainly a mixture of calcium carbonate and calcium hydroxide (slaked lime) with a very small amount of organic matter.

BUG DEATH.

This is put on the market by the Danforth Chemical Co., Leominster, Mass. The sample examined was taken at Medina. It consists largely of the oxides of zinc, lead and iron. It contains some phosphorus.

PRESENT LAW DEFECTIVE.

The law in its present condition is seriously defective, as it fails totally to protect purchasers from adulteration of Paris green with reference to the only material that we have found commonly used as an adulterant, and that is white arsenic. As the law now stands, there is nothing to prevent the addition of any amount of white arsenic to Paris green. The law also fails to define Paris green. In order to make the law really efficient, Paris green should be legally defined and the amount of copper should be taken into consideration as well as the amount of arsenious oxide. It is a matter of congratulation and surprise that with so loosely constructed a law there should be found such a satisfactory condition in the Paris green samples found in the market.

LAW TO PREVENT FRAUD IN THE SALE OF PARIS GREEN.

Laws of New York.— Chap. 113.

AN ACT to amend the agricultural law, to prevent fraud in the sale of Paris green.

Became a law March 23, 1898, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Chapter three hundred and thirty-eight of the laws of eighteen hundred and ninety-three, entitled "An act in relation to agriculture, constituting articles one, two, three, four and five, of chapter thirty-three of the general laws," is hereby

amended by adding a new article to be known as article eight and to read as follows:

ARTICLE VIII.

Section 110. State manufacturer and the dealer in original packages to file certificate with commissioner of agriculture.— After the passage of this act it shall be the duty of each and every manufacturer of Paris green within this state, and of every dealer in original packages of Paris green manufactured outside of this state, before the said Paris green is offered or exposed for sale or sold within this state, to submit to the commissioner of agriculture a written or printed statement setting forth: first, the brands of Paris green to be sold, the number of pounds contained in each package in which it is put upon the market for sale, the name or names of the manufacturers and the place of manufacturing the same; second, the statement shall set forth the amount of arsenic which the said Paris green contains, and the statement so furnished shall be considered as constituting a guarantee to the purchaser that every package of such Paris green contains not less than the amount of arsenic set forth in the statement.

§ 111. Certificate to be given by the commissioner of agriculture to state manufacturer and dealer in original packages.— Every purchaser of Paris green in original packages, which is manufactured outside of this state, who intends to sell or expose the same for sale, and every manufacturer of Paris green within this state shall, after filing the statement above provided for, with

the commissioner of agriculture, receive from the said commissioner of agriculture, a certificate stating that he has complied with the foregoing statement, which certificate shall be furnished without any charge therefor; said certificate when furnished shall authorize the party receiving the same to deal in this state in Paris green. Any person who fails to file the statement aforesaid shall not be entitled to such certificate and shall not be entitled to deal in Paris green within this state; nothing in this section shall be construed as applying to retail dealers.

§ 112. Composition of Paris green or analogous products.— Paris green, or any product analogous to it, when sold, offered or exposed for sale, as such, in this state, shall contain at least fifty per centum of arsenious oxide.

§ 113. Paris green to be analyzed at experiment station.— The director of the New York state agricultural experiment station, at Geneva, shall, under the direction of the commissioner of agriculture, examine, or cause to be examined, the different brands of Paris green, sold, offered or exposed for sale, within the state, and cause samples of the same to be analyzed, and shall report the result of the analysis forthwith to the commissioner of agriculture.

§ 114. Penalty for violations.— Any person or persons, firm, association, company or corporation violating any of the provisions of this act, shall be guilty of a misdemeanor, and shall be fined not less than fifty dollars nor more than two hundred dollars; and in addition thereto shall forfeit and pay unto the people of the state of New York the sum of one hundred dollars, together with the costs of the suit in an action caused to be brought by the commissioner of agriculture in the name of the people of the state of New York, as provided by section eight of the agricultural law.

§ 2. This act shall take effect immediately.

List of Parties Who Have Received Paris Green Certificates.

No. 1. June 21, 1898, F. W. Devoe & C. T. Reynolds Co., cor. Fulton and William streets, N. Y. city.

No. 2. June 21, 1898, Fred. L. Lavanburg, No. 165 William street, N. Y.

No. 3. June 21. 1898, Adler Color and Chemical Works, No. 96 and 98 Maiden Lane, N. Y.

No. 4. June 21, 1898, Lewis Berger & Sons, Ltd., No. 248 Front street, N. Y.

No. 5. July 5, 1898, Morris Hermann & Co., No. 255 Pearl street, N. Y.

No. 6. July 5, 1898, I. Pfeiffer, No. 174 Fulton street, N. Y.

No. 7. July 7, 1898, Highlands Chemical Co., Eugene Waugh, Treas., No. 100 William street, N. Y.

No. 8. July 7, 1898, A. B. Ansbacher & Co., No. 4 Murray street, N. Y.

No. 9. July 7, 1898, Leggett & Brother, No. 301 Pearl street, N. Y.

No. 10. July 9, 1898, Rogers & Pyatt, No. 78–80 Maiden Lane, N. Y.

No. 11. July 11, 1898, Eckstein Brothers, No. 259 Pearl street, N. Y.

No. 12. July 13, 1898, James H. Blanchard, No. 125 Broad street, N. Y.

No. 13. July 13, 1898, Commercial Chemical Co. of the U. S., No. 253 Broadway, N. Y.

No. 14. July 20, 1898, John Lucas, No. 89 Maiden Lane, N. Y.

No. 15. February 16, 1899, Chas. M. Childs & Co., No. 225 Pearl street, N. Y.

No. 16. March 8, 1899, The Bulman-Warner Paint Co., 76 to 84 Ninth street, Brooklyn, N. Y.

No. 18. May 16, 1899, I. Pfeiffer, No. 174 Fulton street, N. Y.

No. 19. May 16, 1899, Fred. L. Lavanburg, No. 165 William street, N. Y.

No. 20. May 16, 1899, James A. Blanchard, No. 125 Broad street, N. Y.

No. 21. May 16, 1899, Lewis Berger & Sons, No. 248 Front street, N. Y.

No. 22. May 18, 1899, Adler Color & Chemical Works, No. 100 William street, N. Y.

No. 23. May 18, 1899, John Lucas & Co., No. 89 Maiden Lane, N. Y.

REPORT

OF THE

Department of Entomology.

V. H. LOWE, *Entomologist.*
F. A. SIRRINE, *Entomologist.**

TABLE OF CONTENTS.

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* At Second Judicial Department Branch Station, Jamaica, Long Island.

REPORT OF THE ENTOMOLOGISTS.

COMBATING THE STRIPED BEETLE ON CUCUMBERS.*

F. A. Sirrine.

SUMMARY.

The striped cucumber beetle[1] in one form or another is injurious to cucumber, melon, and squash vines, from the time the vines start in the spring until the plants are killed by frost.

Only one brood of the beetles occurs during a year on Long Island, but the adults of this brood are injurious at two periods of their lives; in the fall and again, after hibernating in the ground below frost line, in early summer of the next season. The larvæ require moist earth to live in. They feed upon the stems and fruits wherever these come in contact with moist soil.

The striped cucumber beetle cannot be controlled by any one remedy or preventive measure. No remedies can be used to hinder the work of the beetle on the flowers, nor can the work of the larvæ on and within the stems and fruits be prevented. The following combination of remedies and preventive measures is recommended for large fields: First, planting squashes on the margins of the field previous to planting the cucumbers or melons;

* Reprint of Bulletin No. 158.

[1] This pest is wrongly called the "striped bug." It is not a bug, but a beetle, having hard wing-covers. Long Island farmers call it the "cuck beetle," which is more appropriate than "striped bug," or even "cucumber bug."

second, dusting part of the squashes with green arsenite (copper arsenite), combined with spraying the cucumbers or melons with Bordeaux mixture, 1-to-11 formula. For garden patches are recommended: First, planting squashes on the margins of the patch previous to planting the cucumbers or melons; second, dusting part of the squashes with green arsenite, combined with the use of covers over the plants. For fall treatment, either squashes or beans should be planted on the cucumber or melon fields during September, and as soon as the beetles are found feeding upon them, dust the plants with green arsenite.

INTRODUCTION.

Although the striped cucumber beetle has been described and figured, and some remedies for it have been given by Mr. Lowe in Bulletin No. 75 of this Station, results obtained from attempts to control the pest on a large scale in the pickle-growing sections of Long Island, during the past two years, warrant the publication of a separate bulletin. Furthermore, the economic importance of this pest, not only in the market garden sections but throughout the whole State, makes it advisable that farmers should be kept posted as to the best up-to-date methods of controlling its ravages, so that even frequent repetition of old measures is pardonable. In addition, some new facts regarding the life, history and habits have been obtained, which progressive farmers can use to advantage and thus avoid applying remedies at random.

THE STRIPED CUCUMBER BEETLE.

Diabrotica vittata Fab.

Order COLEOPTERA; family CHRYSOMELIDAE.

HISTORY.

The striped cucumber beetle is distinctively a native American pest. It occurs in all parts of the country east of the Rocky Mountains and is always on hand to feed upon squashes, melons

and cucumbers over this whole region, whether planted in small gardens or in large fields.

The earliest record we have of the injuries of this pest was published in 1843 by William Gaylord.[2]

As early as 1864, Dr. Fitch[3] tells us that he has had to use some means for protecting his cucumber vines from the "cucumber bug" for more than twenty years. In 1852, Dr. Harris[4] describes the work of the "striped bug," giving a long list of remedies and stating that a Mr. Levi Bartlett of Warner, N. H., has presented a method of making frames to be covered with millinet for placing over the vines.

INJURY.

Usually farmers complain only of the work of the striped beetle on cucumber, melon, and squash vines at the time the vines are coming out of the ground. Probably the harm done at this time causes the largest amount of loss, but nearly as much damage is produced later by the beetles gnawing the stems of the vines and by their feeding on the flowers; the former weakening the vines and the latter preventing the setting of fruit. Some damage is caused by the larvæ, or grubs, feeding on and within the stems of the vines, but probably no more harm is done to the vine itself by the larvæ, than is done to the fruit, especially of the muskmelon and squash. The larvæ feed upon the rind of the fruits, mining into them, making them rough and warty and producing conditions which afford an excellent foothold for various rots and bacterial diseases. The amount of real wilting of vines, due to the work of the larvæ alone, is slight, but the mining of the stems at or near the roots weakens the vines and aids the work of diseases.

At the time of the appearance of the new brood of beetles, there is little chance for them to injure the old, tough vines, but

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[2] Trans. N. Y. State Agr. Soc., 1843: 127–174.

[3] Tenth Report on the Noxious and Other Insects of the State of New York.

[4] Insects Injurious to Vegetation: 124–126. (Flint's ed., 1852.)

they do cause considerable damage to the fruit itself. They will gnaw away the rind from immature fruits, while on mature cantaloupes they eat holes through the rind and then devour the flesh. This injury to the fruit of muskmelons is very noticeable in market garden sections, especially where there are but few wild flowers, such as golden rod and aster, for the insects to feed upon. The injury they do in the fall is not confined to the fruits of the melon; they often attack late planted beans, devouring not only the leaves, but also the tender pods.

Thus it is seen that this little pest is busy devouring our crops from late spring until driven into winter quarters by freezing weather. In ages past, before they had cultivated crops to eat, they fed upon a few wild species of the gourd family and upon the pollen and flowers of many other plants. They still have this habit of feeding upon the pollen and flowers of plants, but we have no means of estimating the amount of damage done in this way nor have we means of preventing it.

FOOD PLANTS.

It is well known that the striped beetle feeds not only on cucumber, muskmelon, and squash vines, but also on all related *Cucurbitaceae*. In early spring I have found them feeding on the flowers of wild cranesbill (*Geranium maculatum*). In the fall of the year they have been found feeding on the flowers of golden rod and sunflowers. They are also known to feed on beans, peas, and the tassels, silk and kernels of corn. They are said to feed on the flowers of the apple, chokeberry, Juneberry, cherry and related plants, also on the wild balsam apple (*Echinocystis lobata*).

HABITS AND LIFE HISTORY.

Beetle.— On Long Island the adult beetles issue from their winter quarters in the ground at various times between the middle of April and the first of June. During 1897 no beetles were taken

until May 18, while in 1898 none were found until May 30, and during both 1897 and 1898 the adult beetles did not appear in injurious numbers until about June 10. The solitary specimens seen during the latter part of April and even during May appear to be stragglers looking for something to devour. The chances are that these early beetles are so fortunate as to find winter quarters in buildings and under rubbish where they do not have to go so deep into the soil to be beyond the reach of frost as do those that hibernate in the open fields. For this reason we frequently find them during warm days in April and May.

Both males and females feed ravenously for five or ten days (June 5 to 15) after which they commence to mate. Previous to pairing and especially during the first three or four days of their feeding period they eat tender and tough, clean and dirty, and even poisoned leaves and stems. If food is scarce, they will eat cucumber, squash, and melon plants off down to the roots, and dig after those that are not yet out of ground. During this period they also show a decided preference for the squash. Even where the squashes are planted in the same hill with cucumbers or muskmelons the beetles will devour the squashes first.

After their first ravenous appetite is satisfied and they have commenced pairing, they do less feeding and are more particular as to what they eat; feeding then only on the more tender parts of the vines, especially the flowers. At this time they absolutely refuse to feed on any part of the vine that may bear foreign substance on its surface. This habit makes it impossible to kill them with a poison after pairing commences. They will not always leave the treated vines, but do their feeding on the growing tips of the vine and on the flowers. All poisons should, therefore, be applied before pairing commences.

Pairing continues until the middle of August, even though egg laying may have ceased a month before. The tendency to pair is so strong in the males that I have even found them attached to the females of the twelve-spotted beetle.

Egg.—According to observations made in the field during 1898,

egg-laying begins about July 20, but dissections show that the deposition of eggs could begin the latter part of June and that it ceases entirely by the last of July. Hence, the egg-laying period of the beetles, in this section, extends over about one month. It is not known for how long a period an individual beetle continues to deposit eggs, but this period surely varies in different individuals. Specimens in confinement and excited, deposited a large number of eggs in a few hours; many of which were in clusters. In all field observations the eggs have been found deposited singly.

Some writers have stated that the eggs are deposited in the soil and on the stems near the roots. In only one instance have I been able to find an egg near the roots; this was found in a cavity in the stem where the beetle had been feeding. I have frequently found the eggs caught in the hairs of the leaves at the growing tips of the vines. This, together with the fact that very few larvæ compared with the number of beetles which appear in the fall, are found in the stems, especially of muskmelons; and considering that the larvæ have been found feeding on the rind of the fruits of muskmelons, indicates that the eggs are usually dropped wherever the beetle happens to be feeding. Hence, they are just as liable to be dropped on the ground as on the surface of a leaf. Probably the eggs are laid during the middle of the day, and, as the beetles go to the underside of the leaves and even crawl under the vines to find shade, the eggs are generally deposited in these places.

In 1864, Dr. Fitch[5] stated that the eggs are dropped on the ground. A number of other writers state that the eggs are probably deposited below the surface of the ground on the roots of the vines. If these writers are correct in their assumption, the beetles vary considerably in their habits of depositing eggs. The length of time required for the egg to hatch is not known.

Larvae.—According to Dr. Henry Shimer,[6] the larva or grub

[5] Tenth Report on Noxious and Other Insects: 439.

[6] *Prairie Farmer.* August 12, 1865.

requires a month from the time it hatches to obtain its full size. In general, persons who have written anything regarding the striped beetle, since Dr. Shimer's observations were made, have given the same period for the development of the larva. As shown by the author's dissection of female beetles, the egg-laying period can extend from June 20 until the last of July. I have collected half-grown larvæ as early as July 10 and found larvæ still at work as late as September 17; hence, if the eggs are all deposited by the last of July, some of the larvæ must require two months to complete their growth. Probably the length of the larval period depends on the food supply.

F. H. Chittenden[7] says: "The larval period is passed in the earth, at the base of the stalks, and larvæ are often found within the stems above ground."

I have very rarely found the larvæ within the stems of muskmelon, which is apparently too woody for them to penetrate. They are frequently found in the stems of cucumber and squash, but I have not found them in such numbers in these places as upon the rind of the muskmelon fruit where the latter comes in contact with the moist earth. I have also found them working on squash and ripe cucumbers in the same places. In a few instances I have been seen them working on the lower surface of squash vines where the latter come in contact with moist earth. Close examination will reveal the fact that cucumber, squash, and melon vines appear to be eroded at other points besides where they are attached to the root and frequently the fruits will have the same appearance. This is all caused, probably, by the larvæ of the striped cucumber beetle and of the twelve-spotted beetle, where both occur. It surely is their work at the base of the plants and on the fruits of the muskmelon. Hence the statement that the larval period is passed in the earth at the base of the stalks is partially correct, but all facts would be covered better by

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[7] U. S. Dept. Agr., Div. Ent., Bul. No. 10, n. ser.: 28.

stating that the larvæ of the striped cucumber beetle require moist earth to live in and that they feed upon the vines and fruit of the squash, melon and cucumber wherever the latter come in contact with the moist earth. Possibly they feed upon the roots proper, but we have no direct proof of this.

Pupa.— Mr. Chittenden has proven that the pupal or resting stage can be passed in seven days. A number of writers have stated that the pupal stage lasts two weeks. The larva forms an earthen cell in which it changes to a pupa, but does not form a cocoon as stated by some.

Hibernation.—According to Dr. Shimer[8] and Mr. Saunders[9] the striped cucumber beetle passes the winter in the pupal state. This is a mistake, as more recent investigations show that they pass the winter as adult beetles as does the potato beetle. Like the latter they go below the frost line to hibernate.

Number of broods.— Most of the writers to whose work I have access, state that there are several broods of the beetles each year. It is true that the beetles occur in large numbers in the spring and again in the fall, and if the statement that they hibernate as pupæ is correct, then the statement that there are at least two broods each year would be correct also. My field notes show that the beetles begin to decrease in numbers toward the end of July, but do not all disappear until September, and sometimes not until the new brood of beetles appears. Thus beetles can be found throughout the entire summer and fall. In fact, during July, August and September of 1898 I was able to collect beetles every week. The dissections indicate that the beetles collected during August and the first half of September were mostly males and diseased or imperfect females. The dissections of the females of the new brood show also that the reproductive organs are not developed and do not develop even as late as the middle of October. Furthermore, by the dissections it was shown that a large amount of fatty tissue is formed preparatory to hibernation. It addition

[8] *Prairie Farmer.* August 12, 1865.

[9] Insects Injurious to Fruits: 363.

to the above facts, observation in the field showed that there was no tendency to mate during the fall. Hence it is evident that the statement that there is more than one brood each year is wrong. The numerous beetles seen in the spring are the same beetles that were seen in the fall, which have hibernated.

Summary.—At the present time, the known facts regarding the life history and habits of the striped cucumber beetle, combined with what is known of closely related species of beetles, indicate the following cycle: The adult beetles hibernate in the ground below the frost line. In the latitude of Long Island they issue from the ground during May and the first of June, depending somewhat on the weather conditions. They feed ravenously for a few days before they commence to pair. Wherever they chance to be feeding during the latter part of June and during July, there they drop their eggs. The larvæ or grubs require moist earth in which to live; they feed upon the vines and fruit wherever these come in contact with the moist earth. About one month is required by the larvæ to feed and develop, after which they form a small cavity or cell in the ground, and change within this to the pupal or resting stage. The pupal stage lasts from one to two weeks, when the adult beetles emerge. The new brood of beetles commences to appear about the middle of September. At this time but few of the old beetles are left. This new brood feeds greedily until driven into hibernating quarters by frosts.

DESCRIPTION.

The adult striped cucumber beetle, or "striped bug," as it is wrongly called, is too well known to need any description.

As the eggs have never been described, and as the larval and pupal stages are not so well known, they are given.

Egg.[10]— To the unaided eye the egg, when first deposited, appears to be very light yellow in color; nearly round and but

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[10] Shortly after the above description was ready for the printer, I received U. S. Dept. Agr., Div. Ent., Bul. 10, n. ser., in which F. H. Chittenden describes the egg, hence his description has priority.

little larger than the point of an ordinary pin. As seen by the aid of a microscope or good hand lens, it is found to vary in shape from a perfect ellipse to an oval, and is not as pointed as the egg of the corn root worm(*Diabrotica longicornis*), as shown by illustration of the latter as given by Dr. Forbes.[11] They have the same pentagonal markings as have the eggs of the *D. longicornis*. The eggs average 0.69 mm. long and 0.48 mm. wide.

Larva.— The larva, or " grub," would be described by a farmer as a small white wire-worm with a dark brown head and tail; it being hard to tell which end is head and which is tail. In shape, they are nearly cylindrical, about one-thirty-second of an inch wide and varying from one-fourth to five-eighths of an inch in length. With the exception of the head, first segment back of the head and the anal plate, which are dark brown, the body is pure white. The head-end can be distinguished by the fact that the head is only about one-half as wide as the body. The anal plate is as wide as the body, darker colored than the head, in fact, nearly black at the margin. The above are the only characters to be seen without the aid of a hand lens. With the latter, the anal plate will be found to have two minute, upturned teeth on its posterior margin. A few scattering hairs can also be seen. Six small thoracic legs will be found near the head, and one protractile proleg will be found on the ventral side of the anal plate.

Pupa.—During part of the pupal or resting stage, the striped beetle is nearly pure white in color. The peculiar shaped wing pads and folded legs are the most conspicuous part of its body. A few scattering hairs can be seen by the aid of a lens.

PARASITES.

Dipterous.— The dissections show that old beetles, taken during the latter part of July and during August and September, were frequently parasitized with the maggot of a tachinid fly. The eggs

11 Twelfth Report of State Ent. Ill., 1882: 18.

of this fly are laid on the body of the beetles. After hatching from its egg, the maggot eats its way into the body of the beetle where it proceeds to devour its host from within. The parasites undoubtedly cause the retarded development found in many of the beetles when dissected.

Entomologists who have bred these parasites have always obtained but one species of fly; hence I assume that the maggot found by dissections was that of a fly called *Celatoria diabroticae* Shimer.

Worms.— I am unable to find in any of the entomological writings, mention of the fact that a species of nematode, "Eel-worm," occurs as a parasite within the body of the striped beetle. Several beetles were found to have vast numbers of these parasites within their bodies. Whether this worm found by dissection within the bodies of the beetles is closely related to the trichina that infests swine and causes "measly pork" or is related to the anguillule that infests plants, remains to be proven. As all the material was preserved simply for the dissection of the beetle, none of the worms were obtained in the best condition for microscopic study.

REMEDIES.

Although certain classes of agricultural paper writers have annually, for nearly fifty years, recommended various foul-smelling remedies which are warranted to keep the striped beetle away from cucumbers, squashes and melons, this pest continues to be as injurious as ever and seems to be constantly increasing in numbers. If the remedies which are warranted to keep the beetles away from the vines would do so, even though the beetles are not killed, there ought to be a decrease in their number; since, so far as is known, the beetles breed on no plants except the squash, melon, cucumber and plants closely related to them.

POISONS.

As shown under "Habits," there are only two short periods during which the striped cucumber beetle can be actually killed

by poisoning: First, just previous to the time when the beetles commence to pair, and second, during a short period in September and October. Poisoning during the latter period is effective only on areas where fall-flowering weeds are scarce.

Spraying cucumber and melon vines with Paris green and water has often been recommended. Tests during the past two years show that very few beetles are killed by this method and that the risk of killing the vines is too great to allow the measure to be recommended for general use. Instead, I would recommend the use of the poisoned bait which is given under "Trap crops."

PREVENTIVE MEASURES.

COVERINGS.

One of the oldest methods of keeping the beetles from the small plants is the use of covers. As near as I can determine, this method was first used by Dr. Fitch,[12] who in 1865 claims to have used the method for twenty years previous to the time it was published. According to Dr. Harris[13] the use of covers was published in the *New England Farmer* previous to 1852. The cover recommended by Dr. Fitch was, apparently, a crude affair, while that recommended by Mr. Levi Bartlett in the *New England Farmer,* as quoted by Dr. Harris, was apparently just as handy and simple as those recommended in 1889, forty years later, by Professor Weed.[14]

The styles of covers recommended vary from an ordinary box open at top and bottom, the top being covered with cheese cloth or with millinet, to patented wire covers which are costly. The least expensive forms are the box just mentioned; wire or staves bent in a half circle, the ends stuck into the ground over the vines and then covered with cloth, which is held in place by placing dirt along on the edges; and lastly, a box made from two short boards six inches wide and a rectangular cloth. The two ends of the

[12] Tenth Report on Noxious and Other Insects of the State of N. Y.: 440.
[13] Insects Injurious to Vegetation: 125. Flint's ed., 1852.)
[14] Ohio Agr. Exp. Sta. Bul. 13: 146–147.

cloth are tacked to the edges of the boards; short cleats nailed to the boards are inserted into the ground and hold the boards on edge and the free edges of the cloth are covered with dirt.

During 1898, Mr. John O'Donnell, a market gardener of the Borough of Queens, tried the six-inch wire plate-covers on a large scale as shown in Plate XVIII. These cost two cents apiece when bought by the thousand; the cost per acre for first year being a trifle over $40.00. These covers are provided with a tin margin which is very convenient for forcing them into the soil, thus keeping the beetles from working under them. This style of cover answered very nicely until the plants were up but, like all covers they have the disadvantage of protecting the vines only while coming through the ground. If left over the vines too long, the latter are liable to become drawn and weak. At best there is danger when the covers are removed that a heavy wind will injure the vines to such an extent that they will never recover. Besides, all covers have the disadvantage when used alone, of not only giving the beetles a feeding place, but a breeding place when removed.

TIME OF PLANTING.

Growers who raise cucumbers for pickling purposes practice late planting; planting for this purpose during the last week in June and the first week in July and thus avoiding the ravages of the beetles during their spring feeding period. During the past few years, the ravages of the cucumber mildew on the late crop has made it desirable, on the part of pickle growers, to plant earlier. Furthermore, in preparing a grade of pickles known as "dills" an early pickle is preferred. Mr. Chittenden[15] states than in some sections planting in frames and hot houses, and transplanting to the field is advisable. By planting in the field as early as possible, and following the directions given under the head of "Trap-crops," the use of covers for melons and cucumbers can usually be avoided.

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[15] U. S. Dept. Agr., Div. Ent., Circ. No. 31, 2d ser.

TRAP CROPS.

(1) *Beans.*— The bean has often been recommended as a food plant to be used to keep the beetles from cucumbers. In sections of the country where golden rod is not plentiful during the fall, the planting of beans in and along the margins of cucumber and melon fields about September 1 ought to make a good crop upon which to poison the new brood of beetles. As soon as the beetles are noticed feeding upon the bean vines, the latter should be thoroughly dusted with green arsenite (copper arsenite[16]) or even Paris green. Although not tested, I doubt if beans would be a good trap crop to use in the spring unless they were younger and more tender than the vines of the crops being protected. If the beetles cared more for beans than for cucumbers they would be found in the bean fields instead of in the cucumber fields during the spring. Possibly beans could be used in small gardens as a spring trap-crop in connection with covers.

(2) *Squashes.*—In 1898, a series of tests on the use of squashes as a trap-crop the details of which are given under the head of "Field notes," were carried out on an extensive scale in the pickle section of Long Island. The results show that, by planting squashes around the margin of the field where cucumbers or melons are to be planted, the beetles will not disturb the cucumbers, and, if several plantings of the squashes are made and allowed to remain on the field, the beetles will disturb the cucumber vines but little during the whole season. We do not recommend the planting of squashes simply to feed and grow the beetles upon, on condition that they will not disturb the cucumbers, but do recommend their use with other measures as followed in the field tests. Squashes, if used rightly, answer the purpose for which covers are used. The beetles feed on them and thus allow the cucumber and melon vines to make their early growth undisturbed so that they can better withstand later attacks. Further-

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[16] Lead arsenite is also colored and sold under the incorrect name, green arsenite.

PLATE XVIII.—USE OF PLATE-COVERS TO PROTECT YOUNG PLANTS.
Photographed June 15, '98.

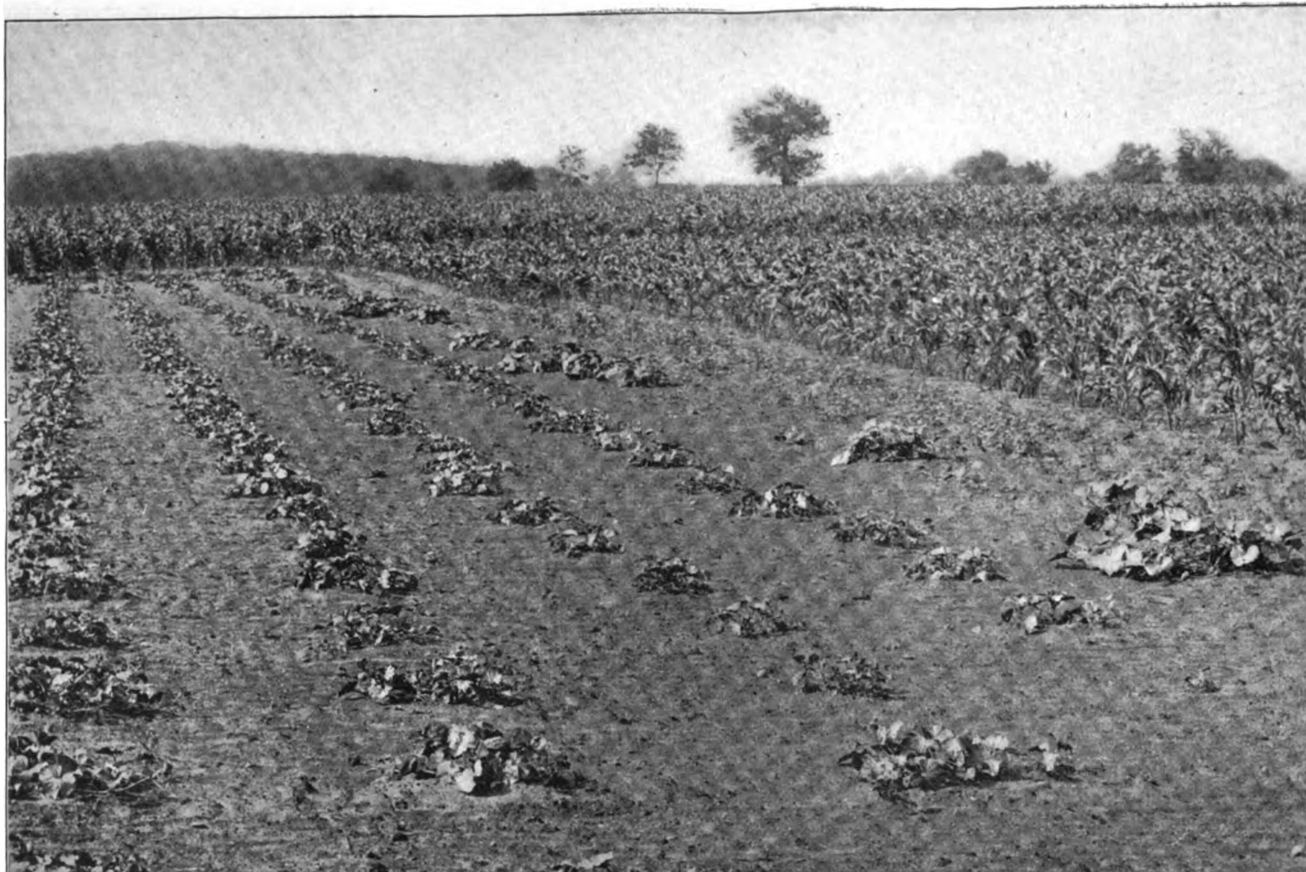

Plate XIX.—Cucumber Field with Squashes on Border.
Photographed June 19, '98.

more, there are a few days during which the beetles can be poisoned on the squashes; hence they are a valuable adjunct even where covers are used.

None of the measures recommended thus far are as valuable when used alone as when several are combined together as was done in the field tests. Possibly the use of Bordeaux mixture and squashes would not be as economical in small gardens as would the use of covers and squashes. For growers of pickles and those who grow cucumbers for market, I would recommend the use of Bordeaux mixture on the cucumber vines and the use of squashes both as a poisoned bait and as a lure. Several rows of squashes should be planted around the margins of the field about four days previous to planting the field with cucumbers or melons, as the case may be. If desired, the squashes can be put in drills a few feet apart, or even sown broadcast. At time of planting the cucumbers, make a second planting of squashes on the margins of the field. If the beetles are very thick, a third planting of squashes had better be made. As soon as the first beetles are seen around the squashes, about one-half of the latter, especially the outside rows, should be thoroughly dusted with green arsenite or any other form of arsenic that can be most easily obtained. Part of the squash plants should be left untreated, for the reason that a rain or heavy dew may follow the application of the poison and kill the treated plants before many beetles are killed. When the cucumbers are fairly up, they should be sprayed with Bordeaux mixture, using four pounds of copper sulphate and four pounds of quick lime to forty-four gallons of water, or what is usually designated as the 1-to-11 formula, for making the mixture. This mixture can be applied most cheaply, while the vines are small, with a knapsack spraying machine. At the time the cucumbers are sprayed, more of the squashes can be dusted with the copper arsenite. If possible, the arsenite should be blown onto all parts of the squash plant, the object being to allow the beetles not a particle of food that is not poisoned. After the beetles commence to pair, the squashes can be cultivated out, although it is well to

leave a few of the plants for the beetles to work upon, especially during the period while the first fruit is setting on the cucumbers; the reason for this being that the beetles prefer the flowers of the squash to those of the cucumber.

Although not absolutely necessary, I would recommend that the cucumbers be sprayed at least three times with Bordeaux mixture; the first spraying being made as soon as the seed leaves are exposed, the second, when the third true leaf is exhibited and the last, just before the plants commence to vine. Each grower must use his own judgment as to the time of these applications. If the vines have an early start, and the beetles appear on the field late in the season, the spraying will have to be carried along later. The cost of three applications of the Bordeaux mixture will not exceed \$2.00 per acre; whereas the cost of wire covers would be \$40.00 per acre and probably they will not last over three years. The treatment with Bordeaux mixture not only makes the vines distasteful to the striped cucumber beetle and to the flea beetle, but also protects the vines from anthracnose and various other diseases to which they are subject. Finally, I would recommend the use of Bordeaux mixture in small gardens after the covers are removed.

Those who cannot afford spraying outfits can use air-slaked lime in connection with covers and squashes, as this will make the cucumber vines unpalatable to the beetles, but it must be remembered that lime is liable to stunt the plants.

In conclusion, it must be borne in mind, that neither Bordeaux mixture nor air-slaked lime will give absolute protection to the vines if the beetles can find no other food plants which they prefer to feed upon.

REPELLANTS AND DRIVERS.

Other remedies in large number have been recommended. Some of them give partial relief, but in most cases their success depends upon the habit of the beetles of being easily frightened away from the plants, especially after they have commenced to

paid. A few of the remedies are distasteful to the beetles, but the difficulty of applying them to all parts of the plants, makes their use only a partial success. When the beetles are frightened from the plants they usually return in a short time. They may not appear to be as numerous, but they will be found scattered over the entire field and hidden in the loose dirt, gnawing off the stems below the surface of the ground. Even the best of these remedies, applied when the beetles first make their appearance, will be found nearly worthless if tested alone; in fact, there are times, except where a trap-crop is used, when nothing but a good wire cover will prevent their damaging the vines. I have even seen them gnaw holes in cloth covers to get at the plants. At such times they should have all the poisoned squash plants they will eat.

(1) *Bordeaux mixture.*[17]— One of the best remedies for making the vines distasteful to the cucumber beetle is Bordeaux mix-

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[17] During the past few years entomologists and mycologists have been recommending the use of Paris green with Bordeaux mixture for various insect, for the following reasons: There is less danger of injury to the foliage from the Paris green; the Bordeaux mixture helps to retain the poison on the foliage longer than Paris green alone would adhere; and, lastly, the application of a fungicide and an insecticide at one and the same time is a saving worth looking after.

Observations and tests on potato and cucumber beetles convince me that if we desire to kill these pests, the Paris green must be used alone, before the Bordeaux mixture is applied.

In 1896, several tests were made on the Colorado potato beetles, to determine effects of Bordeaux mixture as an insecticide. To be sure in each case that every part of the potato plant was thoroughly covered, they were dipped in the Bordeaux mixture, after which they were placed in a breeding cage and a large number of young potato beetles placed on them. Although the plants were kept fresh, not one of the beetles would feed upon them, and all finally starved to death. This test was repeated three times with the same result in each case. The question arises, why not use the Bordeaux mixture as an insecticide? The difficulty is that in the field it is impossible to get the mixture onto all parts of the plants, the result being that potato and cucumber beetles can find places to feed without touching the Bordeaux mixture. Hence, it is seen that when Paris green is used with Bordeaux mixture to kill the above leaf-eating beetles, the value of the Paris green is destroyed. If we wish to kill these pests, the Paris green must be applied alone.

ture. This not only makes the vines offensive, but the application of it drives the beetles away from them. Its use gave just as good results as air-slaked lime; besides it had the advantage, when employed at the rate of four pounds of copper sulphate to forty-four gallons of water, of not injuring or stunting the vines in the least. Furthermore, it can be more uniformly applied to all parts of the vines and it adheres better than air-slaked lime.

(2) *Air-slaked lime.*— Dusting the plants with air-slaked lime has long been recommended and often proves quite successful for driving the beetles from the vines as well as being distasteful to them. But, in order to prove successful, the beetles must not occur in large numbers; must have passed their first feeding period and commenced to pair, or other food plants must be plentiful. Tests during two years convince me that generally the use of air-slaked lime, without a bait crop, causes the beetles to work down next to the root and gnaw at the stems below the surface. It is also liable to be too caustic and stunt the vines. Some have recommended the use of Paris green with air-slaked lime. Tests of this have resulted the same as in the use of Paris green with Bordeaux mixture, viz.: no beetles could be induced to feed upon the parts of the plants protected with the lime and Paris green.

(3) *Other remedies.*— The following mixtures and remedies have been tested along with air-slaked lime: Kerosene mixed with air-slaked lime, turpentine mixed with air-slaked lime, kerosene mixed with land plaster, turpentine mixed with land plaster, rags and corn cobs dipped in kerosene and placed near the plants, and tobacco dust.

The first four gave no better results than air-slaked lime used alone. Land plaster had the advantage of not stunting the vines. Kerosene used on rags and corn cobs, which is said to smell so bad that the beetles will not stay in the same field, was of no value whatever. Tobacco dusted on the leaves and placed around the base of the plants to the depth of one-fourth inch was of no value

in keeping the beetles away. When plants were examined, the day following the treatment, the beetles were found feeding on the plants, and when disturbed, they hid themselves in the tobacco dust at the base of the plants. (These were Long Island "cuck" beetles.) Possibly a good quality of snuff would be more effective than tobacco dust, but it would be an expensive remedy.

Road-dust, ashes, soot, charcoal, salpetre, cow-manure, hen-manure, burdock infusion, slug shot and "bug death" are a few of the numerous measures often recommended which have no value except to frighten the beetles away from the plants at the time they are applied.

CONCLUSION.

From what has been given regarding the habits of the striped beetle, and the results of tests of different remedies, it will be seen that no one measure will give absolute protection to the vines of cucumber and melon. Furthermore, it will be seen that if Paris green, green arsenite or in fact any of the arsenites are used with Bordeaux mixture or with air-slaked lime, with the expectation of killing the beetles, they will be failures. Hence, I recommend the use of squashes as a lure and as a poisoned bait, combined with the use of Bordeaux mixture on the cucumber vines, and in some cases, also combined with the use of covers. I also recommend the planting of squashes or beans in September for the purpose of poisoning as many of the beetles as possible during the fall. Green arsenite and Paris green can be, and frequently are, used with water for poisoning the squashes and beans, but as the object of the latter is to kill as many of the beetles, in as short a time as possible, it is better to use the arsenites dry, for the simple reason that they can be applied stronger and not kill the vines as quickly as when used with water.

FIELD TESTS AND NOTES.

WORK OF 1897.

Plan of test.— The field work of 1897 was carried out on a small garden patch of cucumbers and muskmelons at Floral Park. The vines were planted in drills and thinned after commencing to run. Seven rows of cucumbers were treated as follows, each row being divided into four equal parts:

TREATMENTS USED IN COMBATING STRIPED CUCUMBER BEETLE ON CUCUMBERS.

Row 1..	Bordeaux mixture and Paris green.	Bordeaux mixture and laurel green.	Paris green in water.	Paris green in water.
Row 2..	Resin-lime mixture and Paris green.	Resin-lime mixture and laurel green.	Laurel green in water.	Laurel green in water.
Row 3..	Check.	Check.	Check.	Check.
Row 4..	Tobacco dust.	Air-slaked lime.	Air-slaked lime and turpentine.	Air-slaked lime and kerosene.
Row 5..	Kerosene on rag.	Kerosene on corn cobs.	Plaster and turpentine.	Plaster and kerosene.
Row 6..	V shaped wire covers.	V shaped wire covers.	Dry Paris green.	Dry Paris green.
Row 7..	Cloth covers.	Cloth covers.	Dry laurel green.	Dry laurel green.

The same number of rows of muskmelon were treated in same manner. These measures were started May 25, that is, we did not wait for the beetles to appear before making the first treatment. With the exception of the covers the treatments were repeated as follows: June 1, 11, 14, 23, and July 6. Where Paris green was used in water or dry, the vines were replanted whenever killed.

A summary of the notes shows that none of the above measures except the covers kept all the beetles away and in a few cases the beetles worked through and under the covers. As soon as a cover was removed, the beetles would attack the plants, and where the covers were left over until the vines were ready to run, the plants were twisted and injured by the wind after the covers were removed, so that the plants were worthless.

During the first ten days a few dead beetles were found around the plants treated with dry Paris green.

In all other places where Paris green was used, also in all cases where the laurel green was employed, no dead beetles were found.

In every case where air-slaked lime was used, the plants were stunted.

Of all mixtures and combinations of mixtures the Bordeaux mixture gave the best results. The resin-lime mixture answered as well as the Bordeaux mixture simply because it contained lime.

Kerosene and turpentine used with air-slaked lime or with land plaster gave no better results than air-slaked lime used alone.

Where all the above substances were used, the beetles worked on the under side of the leaves and gnawed the stems below the surface of the ground or wherever they could find a spot not covered with an unpalatable substance. Rags and cobs soaked in kerosene were absolutely worthless; none of the vines were saved by these substances. The same was true of tobacco dust. In fact, the beetles would feed on the leaves that were dusted with tobacco and if disturbed would hide in it, where piled around the base of the vines.

WORK OF 1898.

The tests of 1898 consisted: First, in the use of Bordeaux mixture on the vines we wished to protect; and second, the use of green arsenite dusted on a trap crop of squashes for poisoning the beetles. The tests were made in three distinct localities. One field, consisting of one-third acre of muskmelons, was located at Floral Park, N. Y., on the grounds of John Lewis Childs. Another field, containing two acres of cucumbers, was located at Hicksville, N. Y., on the grounds adjoining the factory of the H. J. Heinz Co., under the management of Mr. Merritt Horner. The third field, containing one acre of cucumbers, was located at Smithtown Branch on the farm of Geo. W. Hallock and Son.

In addition to the above, a test of six-inch wire plate-covers was made on the farm of Mr. John O'Donnell at Jamaica, N. Y. This was an individual test and not under the direction of the Station. We were allowed to note results, but no record of yield was kept.

Plan of tests.— The original plan was to have single rows of squashes planted on the margins of each field before the cucumbers and melons were planted. In addition, arrangements were made for making later plantings between the rows of cucumbers and melons, the distance between being varied. In some cases, cross rows of squashes were planted between every third and fourth row of cucumbers, between every sixth and seventh row, between every ninth and tenth row, between every twelfth and thirteenth row, between every eighteenth and nineteenth row, and between every twenty-fourth and twenty-fifth row.

Preparation.— The first planting of squashes was made as follows: At Floral Park, N. Y., May 18; at Smithtown Branch, N. Y., May 24; and at Hicksville, N. Y., on June 1.

The muskmelons were planted on May 31 and the first cross-rows of squashes planted on same date. The cucumbers were planted at Smithtown Branch on May 31; and the first cross rows of squashes on same date. At Hicksville, N. Y., one acre of cu-

cumbers was planted on June 6, while the second acre of cucumbers was not planted until June 7, and the second planting of squashes was made at same date.

The third planting of squashes was made as follows: At Floral Park, June 14; at Smithtown Branch, June 14; and at Hicksville, N. Y., on June 15.

Treatment.— Cucumbers at Hicksville, N. Y., were sprayed with Bordeaux mixture as follows: June 13, 20 and 29. As there was a bare possibility of killing an occasional beetle, green arsenite was added to the Bordeaux mixture at the first spraying.

June 11, marginal squashes at south end of field where beetles had commenced work were dusted with green arsenite.

June 13, the remaining marginal squashes were treated as follows: One-fourth dusted with green arsenite, one-fourth dusted with lead arsenite, one fourth sprayed with green arsenite in water, one-fourth sprayed with lead arsenite in water. June 24 the first cross rows dusted with green arsenite and lead arsenite; June 29 last planting of cross rows dusted with green arsenite and lead arsenite.

At Floral Park the muskmelons were sprayed with Bordeaux mixture on June 14 and 21 and July 1, green arsenite being used with the mixture at the first spraying.

June 14, the marginal squashes were treated as follows: One-fourth dusted with green arsenite, one-fourth dusted with lead arsenite, one-fourth sprayed with green arsenite and water, one-fourth sprayed with lead arsenite and water; June 21, dusted first cross rows of squashes with green arsenite and lead arsenite.

At Smithtown Branch the field of cucumber vines was sprayed with Bordeaux mixture on June 29 and July 20 and 28. Very few beetles occurred on this field, hence no other treatments were made.

Summary of notes and results.— Melon vines at Floral Park sprayed with Bordeaux mixture (1-to-8 formula) were injured not only the first time when green arsenite was added, but also at the second spraying when the latter was not used.

Green arsenite and lead arsenite, used in water, at the rate of one-half pound to 48 gallons, killed the squash vines sooner than where applied dry. Very few dead beetles were found around the plants sprayed with arsenites in water, while plenty were found dead around plants dusted with green arsenite. Lead arsenite, used dry, did not kill the vines as soon as did the dry green arsenite, but no dead beetles were found where the former was used.

The cucumber beetles did not find the vines at Floral Park until June 14. Though they were quite numerous after this date, not a solitary hill of muskmelons was lost by their work. Enough squashes were kept growing on the margins of the field to furnish them with all the food they required. Plate XIX shows one side of this field taken July 19, with squash plants on margin.

In no case could I find the larvæ working at the base of any of the melon plants, but by the middle of August they were quite plentiful on the underside of the fruits.

By the middle of October the beetles were so numerous that they destroyed all the late set fruits.

The cucumbers at Hicksville were injured by Bordeaux mixture used (1-to-8 formula). Later sprayings (1-to-10 and 1-to-11 formulas) did no harm.

Large numbers of the striped beetles were killed where the first application of green arsenite was made June 11. A few dead beetles were found around squashes dusted with green arsenite June 16, but none were to be found around plants which were dusted with lead arsenite, or even where both arsenites were used in water. Squash plants sprayed with copper and lead arsenites, at the rate of one-fourth pound to 48 gallons of water, were only slightly injured, while in cases where both substances were used dry, the plants were killed.

I never saw such myriads of the striped cucumber beetle as occurred on this field. On the acre of cucumbers planted June 3 nearly every hill was saved, while on that planted June 7 about one-half of the acre had to be replanted three times in order to get a stand. Two factors combined to produce the failure to get

a stand on this late planted acre. First, we had planted only about one-tenth as many marginal squashes at the first planting as was necessary to supply the large number of beetles with food; and, second, at time of first spraying with Bordeaux mixture the late planted cucumbers were just coming up. The result was they could not be thoroughly sprayed, and, as soon as the beetles had devoured the marginal squashes, they went after the cucumbers, even before they were up. It was interesting to note the instinct shown by the beetles in finding the cross rows of squashes as soon as they came up.

Picking on this field was commenced July 30 and continued until September 10. In all 143,455 marketable pickles were obtained from the two acres. These sold for $183.68. The yield per acre was 71,727 pickles and the value per acre $91.84.

At Smithtown Branch but few beetles appeared on the field. These came late in June and fed entirely upon the marginal squashes. The result was a perfect stand of cucumbers. The vines were injured slightly by the first spraying, the 1-to-8 formula being used.

Picking on this acre was commenced July 19 and continued until September 3. A yield of 90,536 marketable pickles, valued at $113.16, was obtained. In addition, 400 ripe cucumbers were sold; about 1,000 ripe cucumbers and 7,000 nubs, actual count, were left on the field; making a total yield of 98,936.

Conclusion.— The results of these tests show three things: First, that if the 1-to-8 formula for Bordeaux mixture is used young cucumber and muskmelon vines will be injured; that it will make the plants unpalatable and drive the beetles as well as any other substance recommended for the latter purpose; and that it is much cheaper than covers. Second, that if green arsenite is used dry on squash vines before the beetles commence to mate, many of the beetles will be killed; also that neither the green arsenite nor the lead arsenite are very valuable if used in water. Third, that a combination of measures must be used, and, that

the beetles must be attacked at the proper season in order to be successful in combating them.

On the supposition that two fields, which were equally well cared for and from which pickles were picked approximately the same number of days, would produce approximately the same number of pickles, some idea of the damage this pest can do to a crop can be obtained by comparing the yield at Smithtown Branch, 90,536 per acre, where, comparatively speaking no beetles occurred, with the yield at Hicksville, 71,727 per acre, where it was a struggle to save the vines. The difference in yield per acre in the two places was 18,809. At least one-half of this difference should be credited to the work of the beetles. If no effort had been made to prevent their work at the latter place, the late planted acre would have been a total failure.

SEXUAL DEVELOPMENT OF THE CUCUMBER BEETLE.

The data given in the following tables are taken from microscopic dissections of material collected during 1898.

SEXUAL DEVELOPMENT OF FEMALE CUCUMBER BEETLE.

I. Specimens taken at Floral Park, N. Y., June 22. Eight females, nine males.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Medium large	Developed	Numerous, half grown		Slightly enlarged.
No. 2	Medium large	Developed	Numerous, one-third grown.		A straight sack.
No. 3	Small	Developed	Numerous, small		A straight sack.
No. 4	Large	Not developed	None		Large.
No. 5	Small	Partially developed.	Very small		A straight sack.
No. 6	Small	Partially developed.	Very small		A straight sack.
No. 7	Small	Partially developed.	Few small		A straight sack.
No. 8	Small	Partially developed.	Few small		A straight sack.

NOTES.— A few pairing specimens were collected on this date. No. 4 was parasitized with nematodes — probably anguillules.

II. Taken at Hicksville, N. Y., June 24. Thirteen females and sixteen males.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Small	Partially developed	Numerous, small		A straight tube.
No. 2	Medium large	Developed	Numerous, one-half grown.		Slightly enlarged.
No. 3	Medium large	Partially developed	Numerous, half developed.		Enlarged.
No. 4	Medium large	Developed	Numerous, two-thirds developed		Large.
No. 5	Medium large	Developed	Numerous, two-thirds developed		Large.
No. 6	Small	Partially developed	Not developed		A straight tube.
No. 7	Small	Partially developed	Numerous, small		A straight tube.
No. 8	Medium large	Developed	Numerous, nearly grown		Slightly enlarged.
No. 9	Small	Not developed	None		A straight tube.
No. 10	Small	Partially developed	Few small		A straight tube.
No. 11	Small	Partially developed	Few small		A straight tube.
No. 12	Medium large	Developed	Numerous, nearly grown		Enlarged.
No. 13	Large	Developed	Numerous, full grown	Few	Large.

NOTE.—A few specimens pairing when collected.

*III. Collected at Hicksville, N. Y., July 6. *Fourteen females, twenty-nine males dissected.*

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Large	Developed		Numerous.	Large.
No. 2	Small	Partially developed	Numerous, small		A straight tube.
No. 3	Medium large	Partially developed	Small		Medium large.
No. 4	Medium large	Developed	Small		A straight tube.
No. 5	Large	Developed	Full grown	Few	Abnormally large.
No. 6	Large	Developed		Numerous.	Large.
No. 7	Medium large	Developed	Numerous, half-grown.		Medium large.
No. 8	Medium large	Developed	Numerous, small		Large.
No. 9	Large	Developed			Very small.
No. 10	Large	Developed	Full grown	Few	Medium size.
No. 11	Small	Partially developed	Numerous, small		Small.

NOTES.— Three specimens of females showed no reproductive organs, but the colon in each was enlarged. No. 4, ovaries developed on one side only. No. 9, apparently had been parasitized.

IV. Collected at Floral Park, N. Y., July 6. Six females and four males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Medium size	Developed	Numerous, small		Small.
No. 2	Medium large	Developed	Numerous, half-grown		Medium large.
No. 3	Medium large	Developed	Two-thirds grown		Medium large.
No. 4	Medium size	Developed	Small		Large.
No. 5	Small	Not developed			Small.
No. 6	Large	Not developed	Few small		Medium large.

NOTES.— No. 3, ovary developed on one side only. No. 5 apparently parasitized. No. 6 parasitized with nematodes, probably anguillules.

V. Collected at Floral Park, N. Y., July 11. Four females and fourteen males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Large	Developed	Numerous, full-grown	Few	Abnormally developed.
No. 2	Large	Developed		Numerous.	Small.
No. 3	Large	Developed		Few	Large.
No. 4	Large	Developed		Few	Very large.

NOTES.— No. 2 had intestine much enlarged. Nos. 3 and 4 were parasitized with tachinids. No. 4 had an ovary on one side only.

VI. Collected at Floral Park, N. Y., July 16. Three females and four males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Shrunken	Small			Small.
No. 2	Large	Developed	Few full grown	Few	Medium large.
No. 3	Large	Developed		Numerous.	Medium large.

NOTE.— No. 1 had apparently been parasitized.

VII. Collected at Floral Park, N. Y., July 21. Five females and five males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Shrunken	Small	Few		Medium large.
No. 2	Medium large	Developed	Few		Medium large.
No. 3	Medium large	Shrunken			Small.
No. 4	Large	Developed	Few	Few	Large.
No. 5	Large	Developed		Numerous.	Large.

Note.— No. 3 parasitized with tachinid maggot.

VIII. Collected at Floral Park, N. Y., July 30. Three females and six males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Large	Developed	Few not developed		Medium large.
No. 2	Shrunken	Shrunken			Small.
No. 3	Shrunken	Shrunken	Few not developed		Medium large.

Note.— No. 1 parasitized with maggot of a tachinid.

IX. Collected at Floral Park, N. Y., August 6. Six females and five males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Large	Calloused in appearance	Few small		Large.
No. 2	Medium large	Calloused in appearance	Few small		Medium large.
No. 3	Large	Calloused in appearance	Few small		Abnormally large
No. 4	Medium large	Developed	Small, numerous		Small.
No. 5	Small		Few small		Very small.
No. 6	Large	Developed	Few small		Very small.

NOTES.—No. 4 apparently checked in development. No. 6 parasitized with maggot of a tachinid, as also was one male.

X. Collected at Floral Park, N. Y., August 9. Four females and five males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Medium large	Shrunken	Few small		Large.
No. 2	Medium large	Shrunken	Few shrunken		Medium large.
No. 3	Medium large	Shrunken	Few shrunken		Medium large.
No. 4	Small	Shrunken			Small.

NOTE.—One male parasitized with maggot of a tachinid.

XI. Collected at Floral Park, N. Y., August 22. Three females and three males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Large	Shrunken	Few shrunken		Small.
No. 2	Small	Shrunken			Medium large.
No. 3	Medium large	Shrunken			Small.

NOTE.— One male and No. 1 parasitized with maggots of a tachinid.

XII. Collected at Floral Park, N. Y., September 14. Eleven females and fourteen males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Shrunken	Calloused	Few small		Large.
No. 2	Large	Developed	Many small		Abnormally large.
No. 3	Small	Not developed			A straight tube.
No. 4	Large				Shrunken.
No. 5	Shrunken	Calloused			
No. 6	Small	Not developed			A straight tube.
No. 7	Small	Not developed			A straight tube.
No. 8	Large	Not developed			A straight tube.
No. 9	Small	Not developed			A straight tube.
No. 10	Shrunken	Calloused			Small.
No. 11	Shrunken	Calloused			Small.

NOTES.— Nos. 1, 2, 4, and 8, and one male parasitized with maggots of a tachinid. Nos. 1 and 2 of males shrunken and organs not distinct.

XIII. Collected at Floral Park, N. Y., September 7. Four females and seven males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Large, shrunken	Shrunken	Few small	....	Small.
No. 2	Large, shrunken	Shrunken	Few small	....	Small.
No. 3	Large	Shrunken	Few small	....	Abnormally large.
No. 4	Medium large.	Shrunken	Few small	....	Large.

NOTE.—Nos. 1 and 3 parasitized with maggot of a tachinid.

XIV. Collected at Floral Park, N. Y., September 23. Two females and three males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1	Shrunken	Calloused.	....	....	Small.
No. 2	Medium large	....	....	....	Very small.

NOTE.—No. 2 and all three males parasitized with maggots of a tachinid.

XV. Collected at Floral Park, N. Y., October 3. Three females and five males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1.	Shrunken	....	......	......	....
No. 2.	Shrunken	....	......	......	....
No. 3.	Small	Not developed.	......	......	A straight pouch.

NOTE.— None of the organs distinguishable in Nos. 1 and 2. Possibly had been parasitized. Three of the males very much shrunken and organs not recognizable.

XVI. Collected at Floral Park, N. Y., October 14. Fourteen females and twenty males dissected.

Females.	Abdomen.	Ovaries.	Ovules.	Eggs.	Copulatory pouch.
No. 1.	Medium size..	Not developed.	......	......	A straight tube.
No. 2.	Medium size..	Not developed.	......	......	A straight tube.
No. 3.	Small	Not developed.	......	......	Very small.
No. 4.	Medium size..	Not developed.	......	......	Very small.
No. 5.	Medium size..	Not developed.	......	......	A straight tube or pouch.
No. 6.	Shrunken	....	......	......	Small.
No. 7.	Shrunken	....	......	......	Small.
No. 8.	Small	Not developed.	......	......	A straight tube.
No. 9.	Small	Not developed.	......	......	A straight tube.
No. 10.	Small	Not developed.	......	......	A straight tube.
No. 11.	Small	Not developed.	......	......	A straight tube.
No. 12.	Small	Not developed.	......	......	A straight tube.
No. 13.	Small	Not developed.	......	......	A straight tube.
No. 14.	Small	Not developed.	......	......	A straight tube.

NOTES.— Nos. 3 and 4 parasitized with maggot of a tachinid; no parasite found in No. 6. The remaining females contained more or less fat or adipose tissue, depending on size. Ten of the males were large and contained a large amount of adipose tissue. The remainder all contained some adipose tissue.

NOTES ON DISSECTION.

In the preceding table the term ovule is used for the eggs until the latter is developed far enough to have a shell or covering formed, after which it is called an egg.

The term copulatory pouch is used for *receptaculum seminis.*

All material was preserved in 2 per ct. formaldehyde. In collecting the beetles for preservation no effort was made to capture more males than females. Those collected during June and July were taken wherever the beetles were congregated on leaves to feed and pair; with the exception of those taken Oct. 3 and 14, those taken after July were collected in flowers of squashes; those taken on Oct. 3 and 14 were collected on the fruits of the muskmelon.

Indirectly the dissections show the excess of males over the females at each period of collecting, but this does not prove that the males exceed the females in number, as there is a possibility that the females secrete themselves while depositing their eggs.

In all about three hundred dissections were made in which the males exceeded the females in the proportion of 3:2.

THE FOREST TENT-CATERPILLAR.*

V. H. Lowe.

SUMMARY.

The forest tent-caterpillar has been unusually destructive during the past season, its ravages extending over a wide area. The caterpillars feed upon the foliage of a large variety of forest, shade, and fruit trees, but during the past season have been especially destructive to sugar maples.

The life history of the insect is similar to that of the apple-tree tent-caterpillar, discussed in Bulletin 152 of this Station, except that the forest tent-caterpillars do not build conspicuous nests.

The insect may be successfully combated in all of its stages, but under most circumstances, is especially susceptible in the caterpillar stage.

INTRODUCTION.

Probably the most important entomological event in this State during the past season was the unusual outbreak of forest tent-caterpillars in Central, Eastern and Northern New York. While this insect is not a newcomer in the forests and orchards of this State, there are no records indicating that it has ever before occurred in such great numbers over so wide an area. Although the caterpillars were unusually numerous in certain sections of the State, the distribution of the species within our borders is not limited to these sections. On the contrary it is found over almost the entire State and in sufficient numbers to make it of much economic importance.

* Reprint of Bulletin No. 159.

The forest tent-caterpillar differs from most species usually discussed in our bulletins in that it is of importance not to the farmer alone, whose fruit and forest trees it readily defoliates, but to the people of the villages and cities as well, when, as during the past season, the hordes of caterpillars defoliate and render unsightly the maple and other shade trees of many village and city streets.

This extensive destruction has created a general interest in the species so that there is a demand from all classes of people for information on the subject. The writer has had the species under observation during most of the past two seasons and has prepared this bulletin with the hope of aiding in disseminating the desired information.

THE FOREST TENT-CATERPILLAR.

Clisiocampa disstria Hubn.

Order LEPIDOPTERA. Family LASIOCAMPIDAE.

CLASSIFICATION AND NAME.

Classification.—As indicated by its scientific name the forest tent-caterpillar belongs to the same genus, and hence to the same order and family as the apple-tree tent-caterpillar discussed in Bulletin 152 of this Station. The two species are closely related and have many similar habits.

Scientific name.— The species was originally described by Hubner,[1] probably in 1822, as *Malacosoma disstria,* but was later referred to the genus *Clisiocampa* established by Curtis in 1828.

Popular name.—The popular name " Forest Tent-Caterpillar " or as occasionally given " The Tent-Caterpillar of the Forest " is in reality a misnomer for the caterpillars seldom spin a true tent, although they have the habit of leaving a thread of silk wherever they go. It has also been referred to by some writers as the " Forest Caterpillar."

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[1] Verzeichniss bekannter Schmetterlinge, p. 122.

HISTORICAL ACCOUNT.

The forest tent-caterpillar is considered a native of Eastern North America. We do not know how long it has been depredating the forests, but its ravages have been noted for more than a hundred years. One of the first authentic references[2] to it was in 1797 with which account probably the first figures of the caterpillar and cocoon are given. That the insect was then known to be a very destructive one is indicated by the statement of Mr. Abbott that it "is sometimes so plentiful in Virginia as to strip the oak trees bare." As a natural result of the settlement of the country, the clearing of the land and the planting of orchards, the depredations of the caterpillars gradually became more noticeable. It is not probable, however, that it was considered a very serious pest in the orchard until 1841, when Harris[3] mentioned it briefly. In 1844 the same writer discussed[4] it more at length, referring to it as "a new depredator of the orchard" as if he considered the habit of feeding upon the foliage of fruit trees a newly acquired one. Like most other insects this species undoubtedly had its periods of abundance and decline, but of this there is little positive evidence in the early references to it. Harris[5] again mentioned it in 1852 as an apple pest, as did Fitch[6] in 1856 and 1858. There appears to be no further indication of extensive injury until 1866 and 1867, when the caterpillars again became very abundant, especially in western New York. Since then there have been frequent accounts of their ravages all along the Atlantic States, the outbreaks usually being confined to quite limited areas. Some of the most important of these were in Maine in 1863, 1867, 1874, 1875 and in 1889; also in South Carolina in 1891 when the caterpillars appeared upon the forest trees in almost incredible numbers. During the past three or four years

[2] Smith and Abbott. Insects of Georgia, p. 117.

[3] Harris. Insects Injurious to Vegetation. 1st ed., p. 271.

[4] New England Farmer, 5: 412.

[5] Harris. Insects Injurious to Vegetation. 2d ed., p. 291.

[6] Fitch. Second and Fifth Reports on the Insects of New York.

there has been a notable increase in the number of caterpillars in New York and throughout the New England States.

But little was written about the history of this insect in the west previous to 1870, when Dr. C. V. Riley[7] mentions its ravages during the previous two years in Arkansas, and also states that "in many parts of Missouri it has been very destructive during the past two summers." From the statements of Riley, Bruner, Murtfeldt and Lugger it appears that the caterpillars have caused a similar and probably equal injury from time to time in the middle states. The extent of its distribution in the west is not definitely known, but it probably occurs sparingly as far west as California.

History in New York State.—Among the first to write about the ravages of the forest tent-caterpillar in this State was Dr. Asa Fitch, our first State Entomologist. There are no indications in his writings that the insect was considered of especial economic importance in this State during the first half of the present century. He refers to it but twice in his fourteen reports. The first reference[8] was in 1856 in which he states that "here at the north this insect is far less common than the other species" (the apple-tree tent-caterpillar, *C. americana*). In this report and later[9] he considers it a serious pest to the oak, but otherwise of no especial economic importance.

One of the earliest outbreaks in the State of which there is a record was in Western New York in 1866 and 1867 when the caterpillars occurred in great numbers upon the foliage of both forest and fruit trees. In 1886 Dr. J. A. Lintner,[10] second State Entomologist of this State, referred to their serious depredations in apple orchards in some sections of the State. During the past ten years this insect has attracted much more attention than at any

7 American Entomologist and Botanist, 2: 245; 261–266.

8 Fitch. Second Report on the Insects of New York. 1856, pp. 198, 199.

9 Fitch. Fifth Report on the Insects of New York. 1859, pp. 820, 822.

10 Lintner, J. A. Third Report, pp. 91, 93; New England Homestead, 20: 229.

time previous. Dr. Lintner[11] recorded the appearance of the caterpillars in great numbers in Washington Co., in 1889–90. They were especially destructive to maple trees. Again in 1893 he referred to their ravages in the apple orchards in certain sections of the State. During 1896 and 1897 the caterpillars were abundant throughout the Central and Northeastern part of the State and during the two following years there were several important outbreaks in some of the timbered sections.

THE RECENT OUTBREAK IN THIS STATE.

Its extent.—Although as previously indicated the forest tent-caterpillar is far from being a newcomer in the State we are unable to find any records which indicate that it has ever before occurred in such great numbers over so wide an area within our borders. To ascertain approximately the extent of the outbreak, letters of inquiry were sent to correspondents in nearly every county in the State. From the data thus secured, together with personal observations in some of the most seriously infested sections of the State, the accompanying map has been prepared (Plate XX). This map is intended to show only approximtaely the area that was most seriously infested. It is not improbable, however, that the caterpillars occurred scatteringly throughout the entire State as they were seen in more or less abundance from Long Island to Buffalo and along the most Northern boundaries of the State. The outbreak was most severe along the Western, Northern and Eastern slopes of the Adirondacks, the valley of the upper Hudson, the Mohawk valley, the Catskill region, in the southern part of Onondaga and Madison, and throughout Cortland, Chenango and Otsego counties, and in the Upper Genesee valley.

Special reports from infested localities.— During the season reports were received from correspondents in localities where the caterpillars were abundant. These reports together with similar facts gained by personal observation are of value principally

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11 Lintner, J. A. Sixth Report, p. 106.

because they furnish information as to the exact distribution of the species. The following are the localities, the name of the nearest postoffice being given: Clinton County — Ellenburg Depot, and five miles southeast and the adjoining town west; West Chazy and locally throughout the Southern and Western part of the County; Peru and vicinity. Warren County — Putnam, Salem and Glens Falls. Washington County — Our correspondent states that the caterpillars were found throughout the county and names the following postoffices: Cambridge, Greenwich, Granville, Salem, Argyle and Whitehall. Saratoga County — Saratoga Springs, Clifton Park, Elnora Station, Fort Edward and throughout the Southern and Eastern part of the County. Schenectady County — Schenectady, Duanesburg and throughout the county. Albany County —Albany and throughout the County. Rensselaer County — Castleton, Nassau, Brainard, Schodack Depot, East Schodack, East Greenbush and West Sand Lake. Green County — South Cairo, Pine Hill and Prattsville. Dutchess County — Fishkill, comparatively few. Delaware County — Cannonsville and Andes. Rockland County — Suffern, not abundant. Orange County — Pine Bush, not abundant. Schoharie County — Cobleshill, Hyndsville, Seward, Sharon, Central Bridge, Schoharie, Middleburg, along the Cherry Valley railroad and throughout the County. Montgomery County — Fultonville and Fort Plain. Fulton County — Johnstown and vicinity. Franklin County — Malone and vicinity. St. Lawrence County — Hammond, Chipman, Gouverneur, Constableville, along the valley of the Black River, Russell, Palmerville, DeGrasse, North Russell, Canton, South Canton, Pierrepont and quite generally over the County. Herkimer County — Little Falls, Herkimer, Ilion, West Schuyler, Frankfort and throughout the County. Warren County — Salem, Glens Falls and Cambridge. Oneida County — Utica, Rome, Waterville Caseville and throughout the County. Otsego County — Unadilla and Worcester. Chenango County — Union Valley, Pitcher Springs and vicinity. Cortland County — Cortland, Cincinnatus and Taylor. Steuben County — Hornells-

ville, Howard, Allen, Alfred, Belmont, Belfast, Belvedere, Birdsall, Canaseraga, West Almond, Almond, Wellsville, Independence, Scio, Bath, Fremont and surrounding towns, Cuba and Olean. Monroe County — Rochester, Brighton and vicinity in limited numbers. Wayne County — Lake Side, not abundant. Ontario County — Geneva and in limited numbers throughout the County. Seneca County — Waterloo. Although few definite reports were received from the extreme Western counties, it is not improbable that the caterpillars were to be found scatteringly at least throughout the western part of the State, as the conditions would be very similar to those in the western New York counties where they were observed.

FOOD PLANTS.

The early references to the food-plants of this insect indicate that it was most destructive to maples, oaks and elms. Later observers have recorded a large number of species of trees, shrubs and vines. The most complete list of food-plants is given by Weed.[12] These represent sixteen families as follows: *Rosaceae,* apple, plum, hawthorn, mountain ash, cherry; *Hamamelidaceae,* sweet gum; *Berberidaceae,* barberry; *Cupuliferae,* beech, birch, oak; *Oleaceae,* ash, fringe tree; *Tiliaceae,* linden; *Salicaceae,* poplar, willow; *Sapindaceae,* maple, horsechestnut; *Cornaceae,* sour gum; *Juglandaceae,* hickory, walnut; *Saxifragaceae,* currant; *Caprifoliaceae,* diervilla, honeysuckle; *Urticaceae,* elm; *Leguminosae,* pea, locust; *Magnoliaceae,* magnolia; *Vitaceae,* woodbine.

During the past season the caterpillars have been especially destructive to sugar maples. Next to the maples they seemed to prefer basswood and elm, but in some localities were especially destructive to poplar and oak. At Little Falls, N. Y., the writer observed them feeding upon ironwood (*Ostryia*), family *Cupuliferae,* making a food-plant additional to the above list.

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12 N. H. Agr. Exp. Sta. Bul. 64, pp. 86–87.

DESCRIPTIONS AND LIFE HISTORY.

The egg.— The eggs are laid close together forming bands which encircle the twigs. These bands or masses are abruptly cut off on the edges and in this the egg-masses of this species differ from those of the apple-tree tent-caterpillar which are more distinctly oval in outline. The frothy covering also differs in color, being a dull gray instead of brown. As referred to on a subsequent page there is a noticeable variation in their size this year. Plate XXI, fig. 1, is from a photograph of two egg-masses which differ greatly in size. The upper one has the more typical shape.

The eggs are placed on end side by side with somewhat more regularity than those of the apple-tree tent-caterpillar. According to Riley[13] the female while depositing her eggs "stations herself, for this purpose, in a transverse position across the twig." The egg-laying habits of three females kept by the writer in the laboratory were carefully noted. The actions of these females indicate that there may be exceptions to the habits observed by Dr. Riley; for none of them placed themselves in a transverse position across the twig, but stood lengthwise of it or nearly so, and moved sidewise while depositing the eggs. When one row was finished the next was immediately commenced. The eggs were placed very close together. With each egg an abundance of frothy glue was discharged, completely covering it and hardening almost immediately. The females died within a few hours after completing oviposition.

When first laid the eggs are nearly white but soon became a dull gray. They measure on the average 1.2 mm. in length and .75 mm. in diameter at the upper end, tapering slightly to the lower end. They squarely cut off at the upper end but rounded at the lower. The upper end is also distinctly margined with white, the central area being darker and somewhat depressed. At first this depression is very slight but gradually more pronounced as the embryo caterpillar becomes fully formed.

[13] Amer. Ent. and Bot., 2: 261.

Small size of the egg-masses this year.—The egg-masses are said to contain from 300 to 400 eggs. Riley states[14] that he found the number in five masses ranging from 380–416. Compared with these figures the egg masses this year are very small as indicated by the examination of a large number taken in the vicinity of Geneva and from various sections of the State. They average only half this size, containing, as a rule, but about 200 eggs. Many were much smaller than this. As each female moth probably deposits all of her eggs in one mass this indicates an unusual falling off in the number of eggs deposited.

Time of egg laying and period of incubation.— In the latitude of New York the eggs are laid during the last week in June and first week in July.

The young caterpillars are fully developed within the eggs before the summer is over, but do not escape until the following spring. On August 29, an examination of eggs showed fully developed caterpillars. Unlike the apple-tree tent-caterpillars which were found bent backward in the eggs examined, all of the caterpillars in about 100 eggs opened by the writer were bent forward nearly double so that the head and posterior part of the body came nearly together.

The larva or caterpillar.— The earliest caterpillars probably appear with the first warm days of spring. This season they were found about Geneva during the last week in March. The period of hatching, however, extends over a month or more, as young caterpillars that had not yet passed their first molt were found at Geneva as late as May 26, and colonies of newly hatched caterpillars were found at various times between, while by May 22 large numbers of caterpillars had reached nearly full size.

Growth.— Under normal conditions the caterpillars are full-grown within about six weeks, but in case they hatch before the leaf buds of their food plants have burst, their development is retarded by lack of food. Cold or inclement weather soon after the

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[14] Amer. Ent. and Bot., 2: 261.

young caterpillars have hatched also delays their growth. Dr. Riley[15] states that the newly hatched caterpillars are able to fast fully three weeks and "to withstand any amount of inclement weather."

Feeding habits.—During the first three or four weeks the caterpillars are gregarious, but as they approach full size, and especially after the last molt they scatter about the tree. During the earlier stages only a portion of the leaf is consumed, but later nearly the entire leaf may be devoured. Weed states[16] that "the caterpillars commonly eat through the leaf in such a way that the outer end drops to the ground," thus causing the insect to be relatively more destructive than if devouring the entire leaf. They feed chiefly during the night, and to a limited extent during the cool of the day. While not feeding they were often seen last season resting in small groups upon the leaves, as shown in Plate XXI, fig. 2, which is from a snap-shot taken on a very warm day at 11:15 A. M. The nature of the injury to the leaves is also shown in this picture.

Silk spinning habit.— From the first the young caterpillars spin a thread of silk wherever they go, but seldom if ever make a true nest. Sometimes a few leaves that the caterpillars have passed over will become covered with silk and attached to adjoining leaves, thus giving the whole the appearance of a rude nest or tent. If disturbed the young caterpillars will drop quickly to the ground. In the bulletin just referred to Dr. Weed reports an observation by Mr. W. F. Fiske to the effect that the young caterpillars when suddenly disturbed while feeding will drop to the ground without attaching a thread. This is also true of the older caterpillars. When congregated upon a twig the young caterpillars are more apt to attach a thread which, however, is quite likely to be broken before the ground is reached. This habit of dropping to the ground when disturbed, as they undoubtedly often are by birds or by the branches swaying in the wind, probably, as

15 Amer. Ent. and Bot., 2: 262.

16 N. H. Agr. Exp. Sta. Bul. 64, pp. 83–84.

Weed has stated, accounts in part, at least, for the large numbers of caterpillars that are seen crawling up the trunks of infested trees. Observations upon caterpillars in confinement showed that much less silk is spun after the last molt while crawling about than during the earlier stages.

Sharing a nest with the apple-tree tent-caterpillar.—What is probably a very unusual occurrence is shown at Plate XXII, fig. 1. This nest was made by a colony of apple-tree tent-caterpillars. It will be observed that most of the caterpillars in sight are not the rightful owners of the nest, but are forest tent-caterpillars. The two species can be easily distinguished as the apple-tree tent-caterpillars have a conspicuous white line extending the whole length of the back, while the forest tent-caterpillars have the line replaced by a row of white spots. This nest was on an apple tree near the Station grounds. At the time this picture was taken, about 10:30 A. M., the caterpillars had collected on the sunny side of the nest. There were none on the opposite side. The writer watched this nest for several days and it was observed that the "guests" went out regularly with the other species to feed and returned with them. Upon no occasion, however, were the forest tent-caterpillars seen to enter the nest. Upon the fourth day the nest was cut open and although it was well filled with apple-tree tent-caterpillars none of the forest tent-caterpillars could be found. A few days after these observations were made Mr. G. G. Atwood reported finding a similar case in an apple orchard a few miles distant. Although it is not uncommon to find two or three stray forest tent-caterpillars upon one of the nests of their near relatives, such cases as the above appear to be quite unusual.

Congregating habit.—A very noticeable habit is that of congregating in large numbers on the trunks and branches of the infested trees. There appear to be two principal occasions for this, first, when resting during the heat of the day and, second, when about to molt. As an indication of the former, the writer

has observed the caterpillars disperse toward evening after having remained together during the greater part of the day. When about to molt their usual places for congregating are upon the branches and trunks of the infested trees. The young caterpillars are more often found upon the former and those that are nearing fully growth upon the latter or on the large limbs of the larger trees. Plates XXIII is from a photograph of a group of caterpillars, most of which were not more than half grown, upon a limb of a young basswood tree. This photograph was taken at 11:30 A. M. In the sections of the State where the caterpillars were very abundant they were frequently found together, when preparing to molt, in such large numbers as to completely cover one side of the trunk of a full-grown sugar maple tree to the distance of three or four feet. Plate XXIV is from a photograph taken at 3:15 P. M., of a comparatively small group of caterpillars about two-thirds grown upon a small plum tree in an orchard near Geneva.

Restlessness of the full-grown caterpillars.—After the last molt the caterpillars become very restless, wandering up and down the trunks, along fences, etc., until finally the cocoons are spun. It has been observed that they feed but little during this period. This was also indicated by the colonies kept in our breeding cages. After the last molt they ate but very little, wandering about for three or four days and finally spinning their cocoons in all parts of the cages.

Number of molts and descriptions.— The number of molts is usually four. A fifth molt occurs soon after the cocoon is spun. The molting periods, with the exception of the first, which was not observed, of a large number of caterpillars confined in breeding cages last spring were as follows: The first molt was about May 8, the second May 16, the third May 31. About ten days later part of them molted a fourth time and within three days spun their cocoons. A small proportion of those that molted but three times spun cocoons. The remainder died. This lack of normal development was probably due to insufficient food as they were accidentally deprived of fresh food for nearly two days be-

tween the third and fourth molts. The periods of molting and the markings were observed and recorded by C. V. Riley[17] in 1870. The following descriptions do not differ essentially from those given by him. The caterpillars just after leaving the eggs measure on the average 2 mm. in length. They are dull black in color with long grayish-white hairs arising from numerous minute tubercles. In a few days there is a slight change in color. The middle of the body becomes lighter, taking on a brownish tinge, while the extremities remain darker. The tubercles also become more distinct and a dark interrupted line conspicuous along each side. These markings become more prominent as the time for the first molt approaches.

The first molt.— The first molt occurs from ten days to three weeks after the caterpillars emerge from the eggs, the variation in time probably depending upon the abundance of the food supply. Immediately after the first molt they measure about one-half inch in length. There are two pale yellowish sub-dorsal lines bordering the dark lines above referred to. These lines become more conspicuous as the time for the second molt approaches; the dorsal spots are also indistinctly seen.

The second molt.— This molt occurs from a week to ten days after the first when the length is about three-fourths of an inch. A row of eleven cream-white somewhat diamond shaped or club-shaped spots extends the full length of the back. Also as Dr. Riley states in the reference above given: "The upper pale line becomes yellow, the lower one white, and the space between them bluish."

The third molt.— The third molt occurs about a week to ten days after the second. The caterpillars measure about one inch in length. There is little change in the markings except that they become more distinct.

The fourth molt.— Between the third and fourth molts is the most rapid-growing period of the larval life. After the fourth

[17] Amer. Ent. and Bot., 2: 262.

molt they measure from one and one-half to two inches in length. Last spring caterpillars that measured two inches were quite common and a few were found that measured two inches and a quarter.

The following technical description is by Dr. Asa Fitch.[18]

"The caterpillar, after it has forsaken its nest and is wandering about, is an inch and a half long and 0.20 thick. It is cylindrical and of a pale blue color, tinged low down on each side with greenish-gray, and is everywhere sprinkled over with black points and dots. Along its back is a row of ten or eleven oval or diamond-shaped white spots, which are similarly sprinkled with black points and dots, and are placed one on the fore part of each segment. Behind each of these spots is a much smaller white spot occupying the middle of each segment. The intervening space is black, which color also forms a border surrounding each of these spots, and on each side is an elevated black dot, from which arise usually four long, black hairs. The hind part of each segment is occupied by three crinkled and more or less interrupted pale orange-yellow lines, which are edged with black. And on each side is a continuous and somewhat broader stripe of the same yellow color, similarly edged on each of its sides with black. Lower down on each side is a paler yellow, or cream-colored stripe, the edges of which are more jagged and irregular than those of the one above it, and this stripe also is bordered with black, broadly and unevenly on its upper side and very narrowly on its lower side. The back is clothed with numerous fine fox-colored hairs, and low down on each side are numerous coarser whitish ones. On the under side is a large, oval, black spot on each segment, except the anterior ones. The legs and pro-legs are black and clothed with short whitish hairs. The head is of a dark bluish color, flecked with numerous black dots and clothed with short blackish and fox-colored hairs. The second segment, or neck, is edged anteriorly with cream white, which color is more broad upon the sides. The third and fourth segments have each a large black spot on each side. The instant it is immersed in spirits, the blue color of caterpillar vanishes and becomes black."

By referring to Plate XXII, fig. 2, the difference in the dorsal markings of the two common species of tent-caterpillars will be plainly seen. The caterpillar on the left is an apple tree tent-caterpillar, the other two are forest tent-caterpillars, the one on the right being a lateral view. All are nearly full-grown and are natural size.

The cocoon.— The cocoons are made of coarse white silk which soon becomes discolored by the weather. In size and shape they

[18] Fitch. Fifth Report on the Insects of New York, p. 821.

closely resemble those of the apple tree tent-caterpillar described on pages 286–287 of Bulletin 152 of this Station, but are somewhat more loosely woven and have less of the yellowish powder. In the vicinity of Geneva the spinning of the cocoons began last season about the last week in May and continued until the middle of July.

Although it has been considered one of the characteristics of this species to utilize a leaf in making the cocoon there were many exceptions last season, for they were found in great numbers upon the fences and out-buildings and even upon the ground, where no leaves were to be had to aid in their construction. This may have been in part due to a scarcity of foliage in the woodlands where the trees had been entirely stripped. In sections where the caterpillars were less common, most of the cocoons were formed in the leaves, the leaf or leaves being brought around the cocoon as shown at Plate XXI, fig. 3. This picture shows a cocoon partly enclosed by two elm leaves held in place by the numerous threads of silk attached to them. Some of the forest tent-caterpillars kept in the breeding cages showed a tendency to forsake this habit; for out of about 150 over half spun their cocoons upon the sides of the cages, the remainder utilizing the leaves that were there in abundance. Most of these caterpillars spun their cocoons during the night, but a few kept in a darkened room began during the latter part of the afternoon. These were observed to require between five and six hours to complete the work. After completing the cocoon the imprisoned caterpillar molts once and then passes to the pupa stage.

The pupa.— Both male and female pupæ are reddish-brown in color. The former measures about five-eighths of an inch in length and the latter three-fourths.

Moths: time of appearance; habits.—Last spring in the vicinity of Geneva the moths were occasionally seen by June 20. A large number of the cocoons gathered from various parts of the State where the caterpillars were very abundant furnish interest-

ing data as to the length of time during which the moths are issuing, the percentage of males and females and the percentage parasitized. As will be observed the moths issued from these cocoons from June 26 to July 8. The data in the following table was obtained from 2,500 of the cocoons.[19]

EMERGENCE OF MOTHS FROM COCOONS OF FOREST TENT-CATERPILLAR.

Dates.	Males	Females
June 26	3	14
June 27	10	10
June 28	10	2
June 29	42	11
June 30	31	5
July 1	73	67
July 3	342	284
July 4	75	84
July 5	132	132
July 6	64	98
July 8	12	25
	794	672

Total males and females	1,466
Number of cocoons parasitized	312
Number cocoons unhatched	722

These figures show that a little over 40 per ct. of the 2,500 cocoons failed to produce moths. Also that less than 47 per ct. of those that hatched were females and that the greatest number of moths escaped during the first five days of July. A little over 12½ per ct. were parasitized and more than 28 per ct. produced neither moths nor parasites.

The moths are active, restless insects. They fly only at dusk and during the night. The females are ready to lay eggs soon

19 Cocoons to the number of 3,757 were sent in from various sections of the State. Nearly 1,000 of them had hatched before being gathered, leaving about 2,700 unhatched. For most of these cocoons the writer is indebted to Mr. A. R. Eastman, Waterville N. Y., Mr. D. H. Burrell, Jr., Little Falls, N. Y., Mr. J. B. Tuckerman, Cassville, N. Y., and Mr. J. M. Budlong, West Schuyler, N. Y.

after leaving the cocoons, but probably live but a short time after the eggs have been deposited. Some female moths kept in the breeding cages laid their eggs within two days after escaping from the cocoon and died before the end of the third day.

Descriptions.— In general the moths resemble those of the apple-tree tent-caterpillar except that the oblique lines across the fore-wings are dark instead of light in color. The general color of typical specimens is buff with a brownish tinge. An examination of a large number of moths showed a wide variation from this even in the individuals that do not approach the varieties, referred to on a subsequent page. Both wings and body are subject to decided shadings of either a yellow or brownish cast. A male moth of average size spreads about one inch, but in the moths reared last spring a few were found that spread but $\frac{7}{8}$ inch and a few that spread $1\frac{1}{8}$ inches. There is less variation in the markings of the females but an equal or greater variation in size. A female of average size was found to spread $1\frac{3}{8}$ inches, the smallest $1\frac{1}{4}$ inches and the largest $1\frac{3}{4}$ inches. The two upper rows of moths on Plate XXV show the variation in size. The upper row are males and the second row females.

The following detailed descriptions of the male and female moths are by Dr. Asa Fitch.[20]

"The male moth usually measures 1.20 inches across its spread wings. Its thorax is densely coated with soft hairs of a nankin-yellow color. Its abdomen is covered with shorter hairs, which are light umber or cinnamon brown on the back and tip and paler or nankin-yellow on the sides. The antennæ are gray, freckled with brown scales and their branches are very dark brown. The face is brown, with tips of the feelers pale gray. The fore-wings are gray, varied more or less with nankin-yellow, and they are divided into three nearly equal portions by two straight dark brown lines, which cross them obliquely, parallel with each other and with the hind margin. * * * The fringe is of the same dark brown color, with the oblique lines, with two whitish alternations towards its outer end. But some times it is of the same color with the wings, and edged along its tip with whitish. The hind wings are of a uniform pale umber or cinnamon brown, sometimes broadly grayish on the outer margin and across their middle a faint darker brown band is usually

[20] Fitch, Asa. Fifth Report, p. 822.

perceptible, its edges on each side indefinite. The fringe is of the same color with the wings, or slightly darker, and is tipped with whitish. The under side is paler umber brown, the hind wings often gray, and both pairs are often crossed by a narrow, dark brown band, which, on the hind wings, are curved outside the middle. All back of this band, on both wings, is often paler, and more so near the band."

"The female is 1.75 inches wide, and in addition to the shortness of the branches of her antennæ, differs from the male in her fore-wings, which are proportionally narrower and longer, with their hind margin cut off more obliquely, and slightly wavy along its edge. Hence, also the dark brown lines cross the wings more obliquely, the hind one in particular forming a much more acute angle with the outer margin. And all the wing back of this line is sometimes paler or of a brownish, ashy color. And the fringe of these wings has not the two whitish alternations which are often so conspicuous in the male. The head and fore part of the thorax is cinnamon brown. The abdomen is black, clothed with brown hairs, though very thinly so on the anterior part of each segment, where these lines are intermingled with silvery gray scales."

Varieties.— Two varieties of this species have been described. Numerous specimens of both were reared from the cocoons above referred to. They are as follows:

Variety *sylvatica* Harr. has the space between the lines filled in forming a broad brown band across each anterior wing. Plate XXV, third row; the two on the left are males and the third a female.

Variety *thoracicoides* Neumoegen and Dyar, has the bands wanting or very obscure. Plate XXV, fourth row; all males.

Among the specimens reared in the laboratory there was an interesting series showing a gradual gradation from the light typical form with the two well marked bands, to the variety *sylvatica* having the space between filled in with brown forming the broad bands as above described. Plate XXV, fifth row.

SUMMARY OF LIFE-HISTORY.

In the latitude of New York State the eggs are usually laid during the last week of June and until about the second week of July. They are placed in bands extending around the twig and are covered with a shining frothy glue. The caterpillars are fully formed in the eggs before the summer is over, but do not escape until early the following spring. They feed upon the foliage of a

large variety of trees and shrubs. They spin a thread of silk wherever they go, but do not build nests. When not feeding or when about to molt they gather often in large numbers upon the limbs or trunks of the infested trees. Pupation takes place during the latter part of May or early in June, the cocoons being placed either upon the leaves or in almost any locality near the ground. The moths appear during the latter part of June and early July. The eggs are at once laid. There is but one annual brood.

NATURAL CHECKS.

The same natural agencies mentioned in Bulletin 152, page 289, as operating against the apple-tree tent-caterpillar probably have an equal influence upon this species. In addition to unfavorable climatic conditions, birds, insects and diseases have a marked effect upon this species. According to Kirkland[21] the common garden toad also feeds upon the caterpillars.

Birds.—A careful study of the birds in the sections of the State which were infested with the caterpillars last spring would undoubtedly have revealed many species not recorded here feeding upon this insect in its various stages. Reports from careful observers together with limited observations by the writer indicate that the following birds feed upon this insect in some of its stages: The black-capped chickadee feeds upon the eggs probably chiefly during the winter when other animal food is not abundant. The writer has taken the eggs from the stomachs of chickadees shot during the winter in localities where the caterpillars were not especially abundant. The yellow-billed cuckoo, Baltimore oriole, American red start, cat bird and robin feed upon the caterpillars. In addition Weed[22] reporting the observations of Miss Soule records chipping sparrows, red and white-eyed vireos, cedar bird, and nut-hatches feeding upon the caterpillars; chickadees upon the cocoons; and robins, chipping sparrows, yel-

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21 Mass. (Hatch) Agr. Exp. Sta. Bul. 46, pp. 22 and 25.

22 Bul. 64, N. H. Agr. Exp. Sta., pp. 91–92.

low birds and English sparrows feeding upon the moths. Undoubtedly many more of our smaller birds feed upon the young caterpillars.

Predaceous insects.— The predaceous insect enemies herein recorded may be divided into two groups: The coleopterous (beetles) and the hemipterous (bugs). The caterpillars fall an easy prey to these enemies when crawling about upon or near the ground. The following are included in the first group: *Calosoma scrutator* Fab., and *Calosoma calidum* Fab., two of our largest species of predaceous ground-beetles, which have frequently been observed attacking caterpillars of various species. Dr. C. V. Riley[23] and Mr. Wm. Saunders[24] were probably the first to record them feeding upon the caterpillars of this species.

According to Felt,[25] Burgess states that *Calosoma wilcoxi* LeC. fed readily in confinement upon the caterpillars. Included in the second group are the two predaceous bugs, *Podisus placidus* Uhler and *Podisus seriventris* Uhler, which Kirkland[26] has recorded feeding upon the caterpillars. Saunders records[27] a species of *Trombidium* feeding upon the eggs.

Parasitic insects.— The parasitic insect enemies may also be divided into two groups: The dipterous parasites and the hymenopterous parasites. Of the former group Coquillett[28] records the following as parasites of the caterpillars: *Euphoracera claripennis* Macq., bred by C. H. Fernald, Amherst, Mass., *Frontinia frenchii* Will., previously recorded by Harvey[29] and *Tachina mella* Walk. also previously recorded by Harvey. During the past season the writer has also bred the last named species together with *Calliphora erythrocephala* Meigen, which Coquillett states is

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23 Amer. Ent. and Bot., 2: 265.

24 Insects Injurious to Fruits, p. 57.

25 Bul. N. Y. State Museum, No. 23, p. 196.

26 Mass. (Hatch) Agr. Exp. Sta. Bul. 46, p. 25.

27 Ann. Rept. Ent. Soc. Ont., 1878, p. 28–30.

28 Bul. No. 7, U. S. Dept. Agr., Div. Ent., Tech. Series, pp. 11, 16, 21, 24.

29 Psyche, May, 1891, p. 85.

evidently a scavenger. Both species were kindly identified by Mr. D. W. Coquillett.

The second group, the hymenopterous parasites, are probably more effectual in keeping the forest tent-caterpillar and other insects in check, because they are usually much more abundant. The following species have been recorded as preying upon the caterpillars: *Limneria fugitiva* Say, recorded[30] by Riley, and *Pimpla pedalis* Cres., by Wm. Saunders.[31] From the 2,500 cocoons kept by the writer in the laboratory 287 individuals of the species *Pimpla conquisitor* were reared, of which 218 were females, leaving 69 males; *Pimpla pedalis,* two females and one male; *Theronia fulvescens,* one male. The following species kindly identified by Mr. Wm. H. Ashmead, assistant curator of the U. S. National Museum, were also reared from these cocoons: *Diglochis* (*Phromalus*) *omnivorous* Walk.; *Miotiopis clisicampae* Ashm. As shown on page 304 but 312 or only about 12½ per ct. of the 2,500 cocoons were parasitized.

Disease.—A disease, evidently bacterial, attacked many of the caterpillars last season materially reducing their numbers. This appears to be the same disease that attacks the apple-tree tent-caterpillar mentioned in Bulletin 152, page 291.

COMBATING THE INSECT.

Owing principally to the fact that the caterpillars attack a large variety of trees, this subject is a somewhat complicated one. In badly infested localities, however, it has three distinct phases. First, combating the insect in the forest; second, combating the insect when attacking shade trees; and third, combating the insect in the orchard. We will discuss the subject under each of the three heads, reversing the order given above.

Combating the insect in the orchard; destroying the eggs.—After the leaves have dropped the egg masses are somewhat conspicuous. When pruning the trees they should be carefully

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30 Insect Life, 3: 157.

31 Insects Injurious to Fruits, p. 57.

looked for and destroyed. If the orchard has been badly infested it will pay to make a special search for them.

Destroying the caterpillars.— Many methods have been suggested for destroying the caterpillars but there are three especially feasible ones, which, if carefully carried out, will usually prove effectual.

First, spraying with an arsenical compound.—Any good arsenical will answer the purpose if applied before the caterpillars are half-grown. Some of the principal arsenical insecticides are Paris green, green arsenite and arsenite of lime. For a discussion of green arsenite and arsenite of lime see Bulletins 143 and 152 of this Station. A third arsenical, arsenate of lead, has been found by the Gypsy Moth Commission of Massachusetts to be especially effectual against the gypsy moth and to be almost harmless to foliage. The formula is as follows: 11 ounces acetate of lead, 4 ounces arsenate of soda, 150 gallons of water. The directions for making arsenate of lead as given by Professor C. H. Fernald[32] are as follows: "Arsenate of lead is easily prepared by putting 11 ounces acetate of lead in 4 quarts of water, in a wooden (not metal) pail, and 4 ounces of arsenate of soda (50 per ct.) in 2 quarts of water in another wooden pail, and when entirely dissolved mixing them in a hogshead containing 150 gallons of water, when a chemical reaction will take place forming arsenate of lead in a fine white powder in suspension of water. If cold water be used in the wooden pails, the solution of the acetate of lead will require a little time, but, however, if the water be hot, it will dissolve very quickly. It is customary to add from 2 to 4 quarts of glucose to the above amount of water. If it is desired to use larger proportions of the arsenate of lead, it is only necessary to use more acetate of lead and arsenate of soda, but *always* in the proportions given above." To ensure success in spraying two points should be kept in mind, namely, promptness and thoroughness. The poison will be much more effective if applied before the caterpillars are

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32 Ann. Rept. Mass. Bd. Agr. 1897.

one-fourth grown and of but little avail if the application is delayed until after they are half grown.

Second, destroying the caterpillars when they have assembled upon the trunks or large branches.— This may be done in any convenient way. A very easy way is to crush them with an old broom which, to insure the death of all the caterpillars it touches, has been dipped in kerosene oil. The kerosene oil is fatal to them, and if preferred may be sprayed directly upon them.

Third, jarring and banding.— Jarring is seldom practical except with small trees. The tree should be given a few quick, sharp raps with a padded mallet. The caterpillars will drop at once and may be collected and destroyed in curculio carts or upon sheets spread upon the ground.

Banding is for the purpose of preventing those caterpillars that have been jarred off by the wind, or by birds, or have left the tree during the restless period just previous to pupating, from again ascending the trunk; also to protect the trees from invading caterpillars, especially when the orchard is situated near infested shade or forest trees. The bands may be made of cotton wool in which the caterpillars will become entangled, or better by some sticky substance such as tar mixed with two parts of raw oil, or with raupenleim. Either of these substances should be smeared upon bands of paper at least a foot wide which can be tied around the trunks of the trees. By using the paper there is no danger of injury to the bark. Sticky fly paper is sometimes successfully used in the same way. The caterpillars will be caught upon these bands and soon die. Where the caterpillars are very abundant so many will be caught upon the bands that other caterpillars can crawl safely over them. In such an event new bands will have to be applied or the originals made wider. Of these sticky substances raupenleim is one of the best. It can be obtained of William Meuzel & Co., 64 Broad St., New York, and the Bowker Fertilizer Co., Boston. It should never be applied directly to the bark.

Collecting the cocoons.—Many of the cocoons are spun in places where they can be easily reached. In collecting and destroying them many useful parasites would be destroyed but in case of a serious outbreak the thorough collecting of the cocoons would accomplish more immediate good than the parasites. It would, however, be but little trouble to place the cocoons under a coarse netting and leave them until the parasites had escaped. The netting should be too fine to allow the moths to pass but coarse enough to allow the parasites to escape.

Capturing the moths.—As previously stated the moths fly at dusk or later. They are attracted by a bright light, and may be captured by placing a lighted lantern over a tub of water, over which enough kerosene oil has been poured to make a thin film. The moths flying about the light will fall into the water. While this method may be of some value it is doubtful if many female moths will fly to the light before having deposited their eggs, after which of course, it makes no difference whether they are attracted to the light or not.

Combating the insect when attacking shade trees.—All of the methods just described can be used to check the insect when attacking small shade trees. For large trees banding is of much value. In some of the villages in which the caterpillars were abundant last spring, they were dislodged from the large trees by streams of hydrant water and prevented from going back up the trunks by the sticky bands. For spraying the large trees special apparatus is required. Steam power is usually used. A suitable outfit can be purchased for from about $200 up. The increase of shade tree insect pests and diseases make it almost necessary for a village to own a spraying apparatus to ensure the preservation of its shade trees.

A method of combating the insects which has been tried with success is to encourage the school children to collect the egg masses by paying them a reasonable price per hundred. This may be done by the private individual or by the village or city authori-

ties. In either case the expense would be trifling in comparison with the good accomplished.

Combating the insect when attacking forest trees.—When the caterpillars occur in such great numbers over such wide areas of woodland as they did last spring it is difficult to devise a method of destroying the caterpillars that would be practical for individual farmers to undertake. Banding the trees will be of much value. Also with comparatively little work many of the caterpillars which have assembled on the trunks can be destroyed. Whatever is done a united effort will be necessary to give the best results.

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Munson, W. M. Rural New Yorker, 58: 421. Recommends lead and sulphur, equal parts, put on paper and tied around trunks to prevent caterpillars ascending.

DESCRIPTION OF PLATES.

Plate XX.— Area over which the caterpillars were most destructive in New York State during 1899.

Plate XXI.— 1. *Egg mases, natural size.* 2. *Caterpillars at rest during the heat of the day.* 3. *Cocoon between two elm leaves, natural size.* (*Original.*)

Plate XXII.— 1. *Nest of apple-tree tent-caterpillars containing both species.* 2. *Showing principal difference in markings between the two species. The one on the left is the apple-tree tent-caterpillar, all about two-thirds grown. Natural size.* (*Original.*)

Plate XXIII.— Young caterpillars congregated upon a small basswood branch. (*Original.*)

Plate XXIV.— Caterpillars congregated upon trunk of plum tree preparing for last molt. (*Original.*)

Plate XXV.— First two rows male and female moths of Clisiocampa, disstria *Hubn, showing markings and variation in size. Third row,* C. disstria *var.* sylvatica *Harr; the two on the left are males and the third a female. Fourth row,* C. disstria *var.* thoracicoides, *Neumoegen and Dyar; all males. Fifth row shows gradation from light form with two narrow dark lines across each fore wing to dark form with dark band across the wings; all males. All natural size.* (*Original.*)

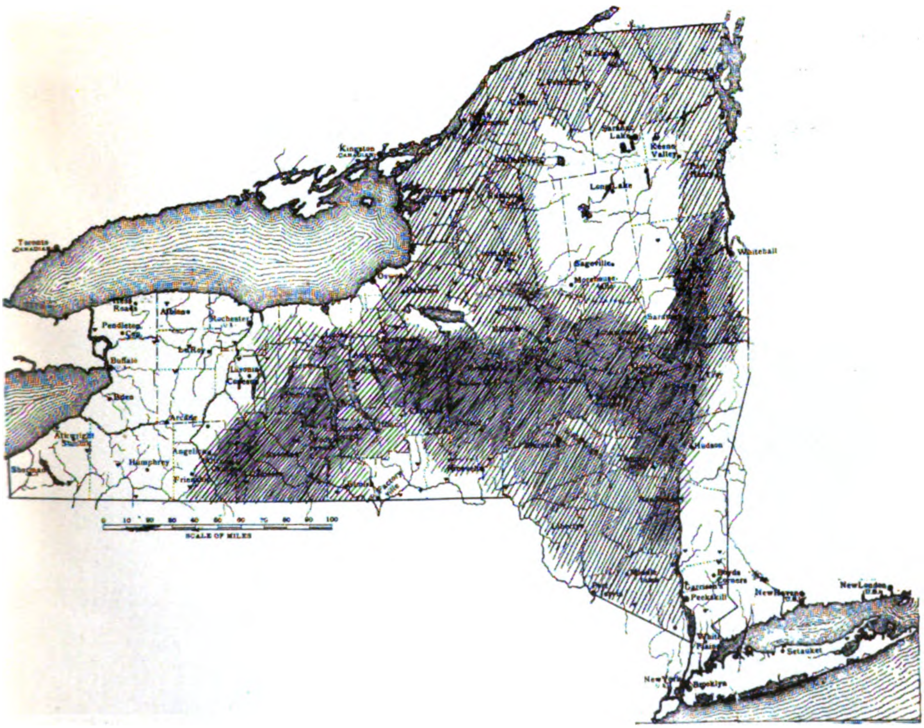

Kingston
Buffalo
Rochester
Humphrey
Long Lake
Hudson
Peekskill
Setauket
SCALE OF MILES

PLATE XX.

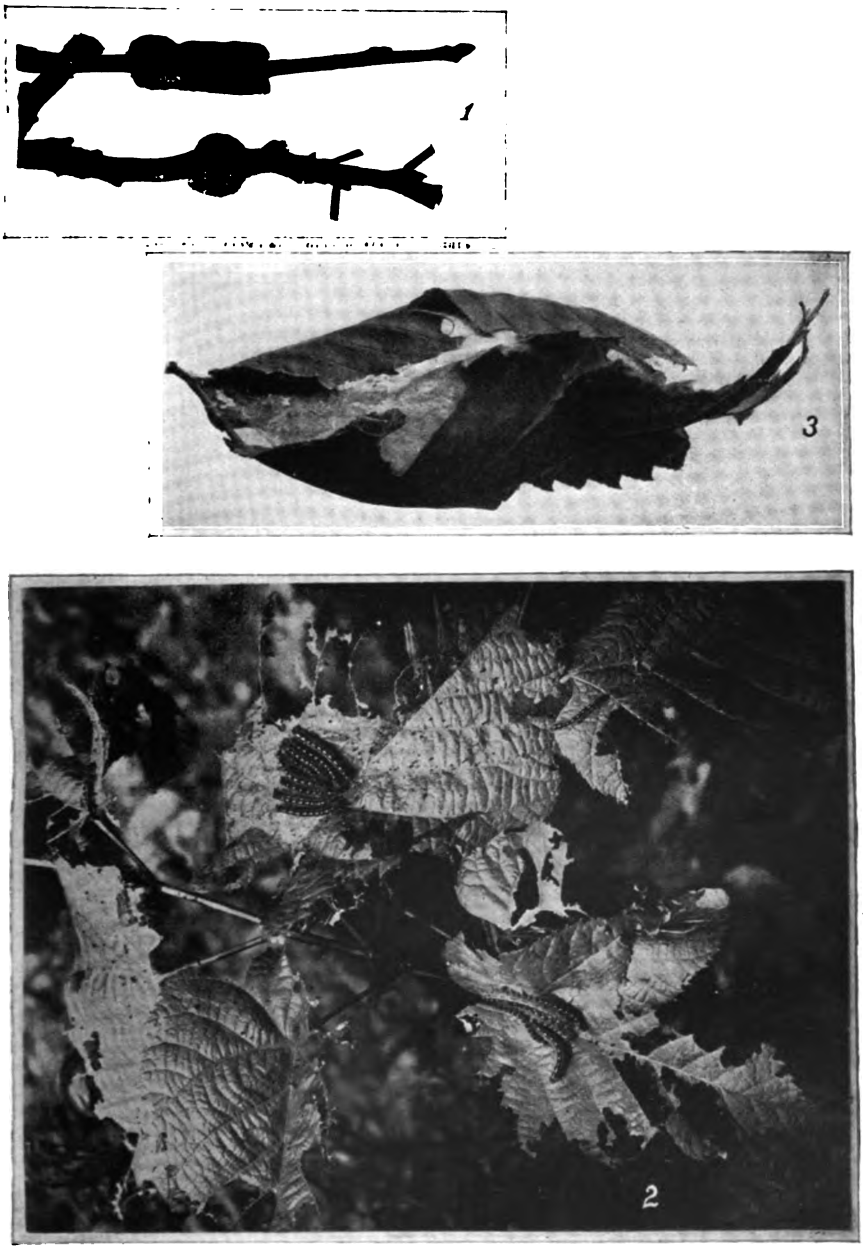
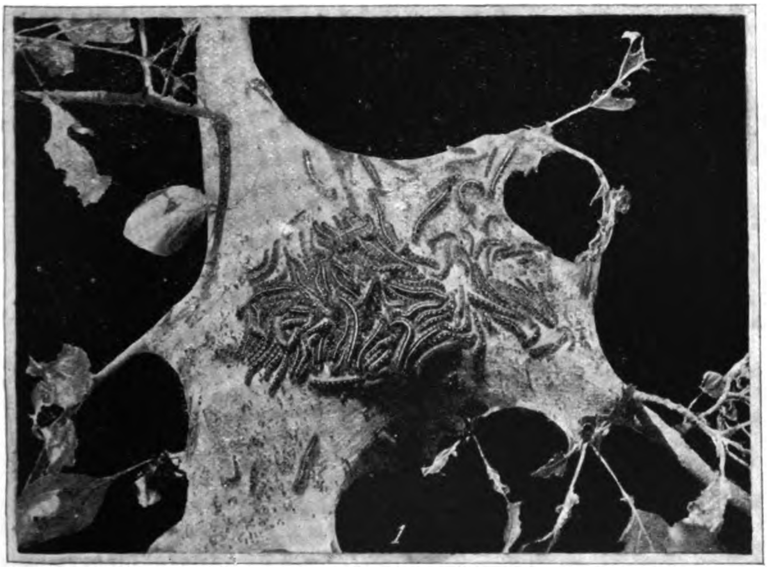


Plate XXI.



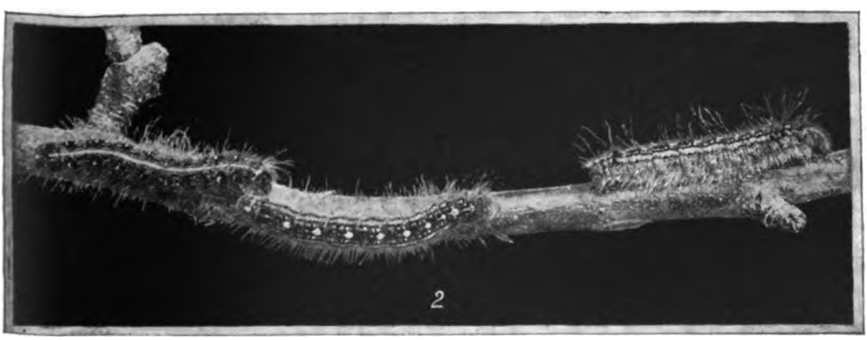


PLATE XXII.

Plate XXIII.

PLATE XXIV.

Plate XXV.

REPORT

OF THE

Horticultural Department.

S. A. Beach, *Horticulturist.*
Wendell Paddock, *Assistant.*
C. P. Close, *Assistant.*

Table of Contents.

REPORT OF THE HORTICULTURIST.

TREATMENT FOR GOOSEBERRY MILDEW.*

C. P. CLOSE.

SUMMARY.

For three seasons, Bordeaux mixture, lysol and formalin have been compared with potassium sulphide, the latter giving the best results in all three series.

The Bordeaux mixture proved comparatively valueless, as in but one series of tests did treated bushes show less mildew than check bushes; formalin in the strongest solution, 1 oz. to 1 gal. water, gave fair results, but weaker solutions ranked with the Bordeaux mixture; lysol gave promising results, coming next to the potassium sulphide in reduction of mildew injury.

With one exception, Bordeaux mixture, very early spraying gave better results than medium early or late treatments.

Winter treatment was tested during one season, but did not give sufficiently favorable results to justify recommendation.

INTRODUCTION.

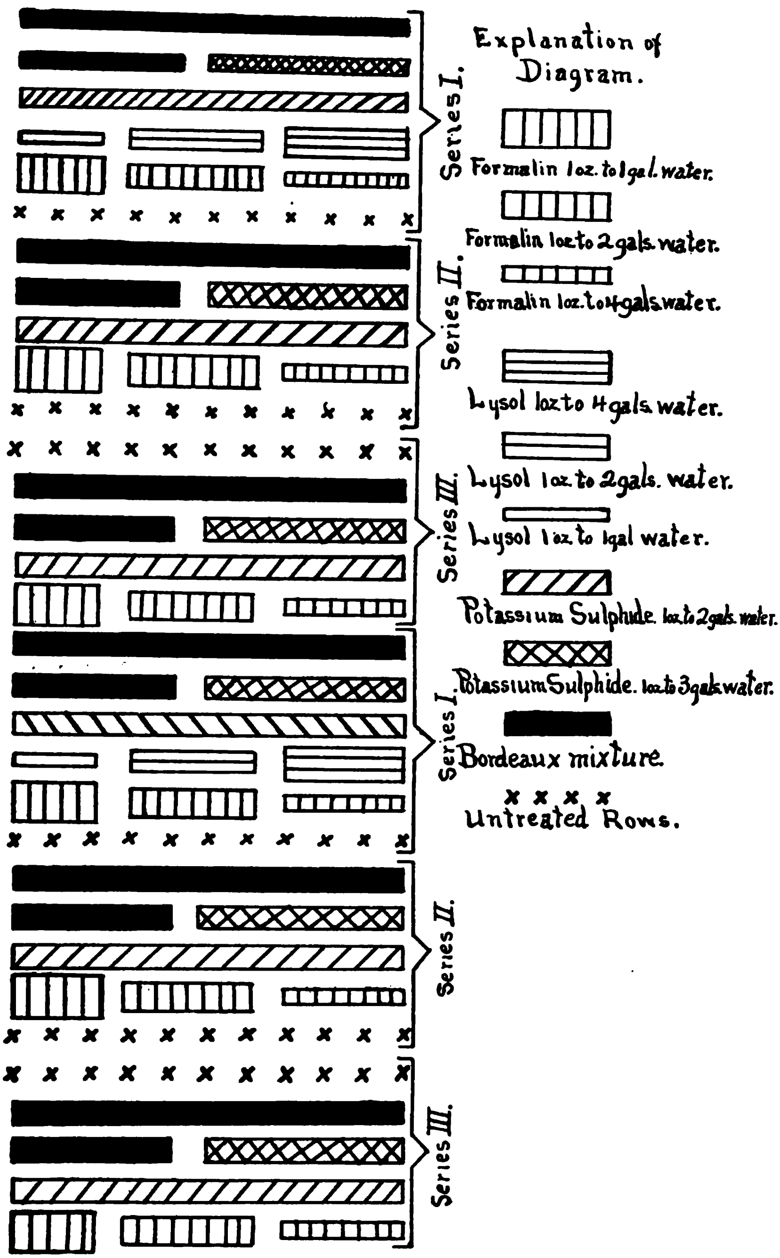
The gooseberry mildew generally makes its appearance during the last half of May or first half of June. It is first noticed as glistening, frost-like spots on the fruit on the lower part of the bush where there is usually dense shade. As the disease progresses the spots enlarge, turn dark brown and form a felt like covering over a part, or all, of the berry. In a slight attack the disease

* Reprint of Bulletin No. 161.

may not injure the fruit at all, or only slightly deform it. In a bad attack the fruit has a repulsive appearance, is stunted in development, and may be more or less decayed.

Two or three weeks after the mildew attacks the fruit it appears on the young, tender twigs, especially on their tips. If the attack is severe the new growth will be destroyed and the older growth will be considerably injured. In case of a very severe attack the fruit will be rendered worthless, and the foliage will be nearly, or entirely, killed during July. As a result no fruit buds are set for the next year's crop, and the bushes are so badly weakened that they may suffer from winter injury. In a few commercial plantations where little or no spraying has been done the writer has seen the crop of fruit destroyed and the bushes practically ruined by this disease. In other plantations where spraying was carefully done the greater part of the crop was saved, the foliage remained in good condition and fruit buds were set for a succeeding crop. The extent to which mildew can be prevented by spraying depends upon weather conditions and location. In a wet season like that of 1898 it flourishes abundantly and is difficult to control. The disease, as already stated, usually obtains a foothold on the lower parts of the bushes where the shade is dense. These parts are very difficult to reach thoroughly with spray solutions, and in a year when the other conditions favor the spread of the fungus, are liable to harbor more or less of the disease unless the greatest care and thoroughness are used in spraying. In a dry season like the present one mildew can be almost entirely prevented by thorough use of fungicides. On uneven ground the higher parts of a plantation seem to be less subject to the disease than the lower parts. The best location seems to be one well elevated, with a gradual slope affording good air drainage.

In view of the destructive character of gooseberry mildew and its economic importance in all parts of America where gooseberries are grown, either for home use or for market, it was decided to undertake experiments in treating the disease on a commercial scale. The object of the experiments was to compare the potassium sulphide treatment with treatments with other fungicides


Series I.
Series II.
Series III.
Series I.
Series II.
Series III.
Explanation of Diagram.
Formalin 1oz. to 1 gal. water.
Formalin 1oz. to 2 gals. water.
Formalin 1oz. to 4 gals. water.
Lysol 1oz. to 4 gals. water.
Lysol 1oz. to 2 gals. water.
Lysol 1oz. to 1 gal water.
Potassium Sulphide. 1oz. to 2 gals. water.
Potassium Sulphide. 1oz. to 3 gals. water.
Bordeaux mixture.
Untreated Rows.

and at the same time to compare very early treatments with later treatments and thus learn at what periods spraying should be done to accomplish the best results.

These investigations were begun in 1897 and have been continued for three seasons. Two commercial plantations have been under experiment. One belonging to King & Robinson is located at Trumansburg on the slopes just west of Cayuga Lake. This was treated three seasons. The other belonging to the Van Dusen Nursery Co., Geneva, and located on the upland about two miles west of Seneca Lake, was treated in 1899 only. A preliminary report giving the results of the work in 1897 may be found in Bulletin 133. A complete report of the investigations for the entire period from 1897 to 1899 is now presented for the first time.

TRUMANSBURG EXPERIMENTS.

PLAN.

The plantation at Trumansburg consists of 32 rows with 11 plants to the row. As shown in the diagram opposite it was divided into six plats. Each treatment was given to two plats located in different parts of the plantation. This arrangement was for the purpose of equalizing for each remedy the differences in soil and location which might exist in different parts of the plantation.

For convenience in comparing the effects of very early with medium and late spraying, three series of treatments were made. Series I was begun very early just as the buds were breaking and successive applications were made at intervals of about ten days until seven had been given. Series II was begun when the second spraying of Series I was made. Series III was begun when Series I received its third spraying and Series II its second spraying. During the remainder of the season the dates of treatment were the same for all three series. An untreated row was left as a check for each series.

FUNGICIDES USED.

Bordeaux mixture (ordinary), 1 to 11 formula, was used until the last two or three sprayings when potassium sulphide, 1 oz. to 2 gallons water, was substituted for it. This substitution was made so that the fruit would not be spotted with Bordeaux mixture at the time it was picked for market.

Lysol and formalin were each used in three strengths, 1 oz. to 1 gal. water, 1 oz. to 2 gals. and 1 oz to 4 gals.; and potassium sulphide in two strengths, 1 oz. to 2 gals. and 1 oz. to 3 gals. water.

Applications of these materials were made with a bucket force pump fitted with a Bordeaux nozzle. No injury was done to the foliage by any of the solutions.

OBSERVATIONS AND DATES OF TREATMENTS.

Tests in 1897.— The first spraying was made April 12 just as the buds were bursting. This was followed by applications April 23, May 5, 17, 26, June 7 and 21. The bushes made a good growth and had a good setting of fruit. Mildew was found in small amounts on the fruit May 26. This developed rapidly on the fruit and by June 7 had spread to the new growth. A careful examination revealed less mildew on the bushes treated with potassium sulphide than on the other treated or untreated bushes.

As it was desired to market the fruit green, the last spraying was made June 21 and the fruit was picked early in July.

Tests in 1898.— Owing to the very mild weather early in March the buds began to open and by the middle of the month were in condition for the first spraying. They were not sprayed, however, because it seemed that cold weather must come and check the premature growth, hence it would be useless to spray until continuous growth might be expected. Contrary to expectation the latter part of March was not unfavorable to a slow growth and by April 1 when the first spraying was made the growth was about ten days in advance of what is desirable at the time of first application. Later applications were made April 14, 26, May 9, 21, June 1 and June 13. There was an abundance of moisture

Plate XXVI.—Crown Bob Gooseberry Affected by Mildew. A Perfect Berry in Lower Right Hand Corner.

PLATE XXVII.—STAGES AT WHICH SPRAYING SHOULD BE GIVEN FOR MILDEW.

during the season which seemed to favor a rapid growth of mildew. The disease was first noticed May 25. It was quite generally distributed throughout the plantation but was most abundant on the untreated rows. The fruit was marketed green the latter part of June.

Tests in 1899.— The weather was unfavorable to early growth so the first spraying was not made until April 15. Later sprayings were made April 25, May 5, 15, 25, June 6 and 12.

The season was dry and the attack of mildew was comparatively light, although the bushes made an excellent growth and set a fair crop of fruit. Mildew appeared early in June and was especially noticeable on the check rows and on the under side of bushes sprayed with Bordeaux mixture. The young growth was exempt from the disease. The fruit was picked the last of June.

RESULTS.

Table I shows the different strengths of the various fungicides used and the percentage of mildew for the three years in each series and each treatment in the series.

TABLE I.— PERCENTAGE OF MILDEWED FRUIT FOR THREE SEASONS.

Fungicide.	Series I. Spraying begun very early. Seven applications.			Series II. Spraying begun medium early. Six applications.			Series III. Spraying begun late. Five applications.		
	1897.	1898.	1898.	1897.	1898.	1899.	1897.	1898.	1899.
*Bordeaux mixture:									
1 to 11 formula	37.4	66.7	60.6	29.1	80.9	53.2	58.	90.5	63.
Potassium sulphide:									
1 oz. to 2 gals water..	6.6	29.3	5.5	12.3	42.7	3.5	11.5	37.9	15.1
1 oz. to 3 gals. water..	5.	50.9	6.6	15.1	69.5	7.5	13.	66.3	6.6
Formalin:									
1 oz. to 1 gal. water...	48.8	59.9	8.9	78.3	80.9	11.2	56.	63.4	8.8
1 oz. to 2 gals. water..	59.1	84.	15.	84.7	91.9	14.9	71.4	96.8	37.5
1 oz. to 4 gals. water..	52.6	95.1	16.1	65.	86.7	16.2	70.4	89.1	41.9
Checks	57.7	80.8	22.6	78.7	98.	28.5	78.7	95.7	30.6
Lysol:									
1 oz. to 1 gal. water...	24.5	74.2	6.6	....	....	....	....	....	....
1 oz. to 2 gals. water..	56.8	81.6	8.2	....	....	....	....	....	....
1 oz. to 4 gals. water..	37.1	65.1	10.9	....	....	....	....	....	....

* Last three treatments in each series in 1897, and last two treatments in each series in 1898 and 1899, potassium sulphide, 1 ounce to 2 gallons water.

Table II shows the average percentage of mildew for each series and treatment for three seasons.

TABLE II.— AVERAGE PERCENTAGES OF MILDEWED FRUIT FOR THREE SEASONS.

Fungicide.	Series I.	Series II.	Series III.
Bordeaux	54.9	54.4	70.5
Potassium sulphide:			
1–2	13.8	19.5	21.5
1–3	20.8	30.7	28.6
Formalin:			
1–1	39.2	56.8	42.7
1–2	52.7	63.8	68.6
1–4	54.6	55.9	67.1
Checks	53.7	68.4	68.3
Lysol:			
1–1	35.1	....	....
1–2	48.9	....	....
1–4	37.7	....	....

A comparison of the averages in Table II shows that potassium sulphide treatment, 1 oz. to 2 gals. water, gave the best results in all three series, the best result being in Series I where spraying was begun very early. This shows 40 per ct. less mildew than the check rows do. A weaker solution of the same material gave the next best results and here again the very early treatment of Series I is most favorable, being 23 per ct. better than untreated.

The results with lysol are promising, the strongest solution, 1 oz. to 1 gal. water, reducing the amount of mildew 18 per ct. With formalin, the treatment in Series I, using 1 oz. to 1 gal. water, was much the best, reducing the amount of mildew 14 per ct. In most other cases the tests with formalin rank with the results obtained from the use of Bordeaux mixture, which in Series II only is better than the untreated rows. In Series I and Series III the tests with Bordeaux mixture actually show a larger percentage of mildew than do the check rows. With the exception of Bordeaux mixture in Series II the very early treatments of Series I gave the best results with all tests.

The cost of the material for the remedy giving the best results, potassium sulphide, 1 oz. to 2 gals. water, is about three tenths of 1 cent per bush for seven applications per season.

GENEVA EXPERIMENTS.

PLAN.

The tests were carried on in the Industry plantation of the Van Dusen Nursery Co., near Geneva. During the past few seasons the attacks of mildew here were so severe that the crops were destroyed and many bushes had been either killed outright or so badly weakened that they were winter killed. The part of the plantation used for this work contained 28 rows, 20 bushes to the row.

The general plan of the work in this plantation was much like that for the work done at Trumansburg. The principal new feature was "winter spraying" with several fungicides. This was for the purpose of determining whether or not it would prove practical to spray with strong solutions while the bushes are dormant. The object was to compare the results obtained from bushes given the winter treatment and sprayed throughout the season, with results from bushes where spraying was begun early, medium early and late; also to compare soda-Bordeaux and copper carbonate solutions with potassium sulphide as a preventive of the disease.

WINTER TREATMENT.

The severe weather of winter and early spring prevented the application of this treatment until April 5, but as the buds remained perfectly dormant all that time this date was satisfactory for the test. Each one of the following solutions was applied to a separate row of bushes:

Copper sulphate, 1 oz. to 1 gal. water.

Potassium sulphide, 1 oz. to 1 gal. water.

Iron sulphate, saturated solution, 5 pounds to 1 gal. water, plus 1 per cent of sulphuric acid.

[1]Soda-Bordeaux mixture.— 1pound copper sulphate, 1-3 pound lye, to 5 gals. water.

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[1] A modification of Dr. Halsted's formula, as given in Nineteenth Report New Jersey Exp't Station, p. 336.

Copper carbonate 1 oz., ammonia to dissolve it, 5 gals. water.

Copper carbonate 3.2 oz., sodium carbonate 1.6 oz., ammonia to dissolve them, 5 gals. water.

For the remainder of the season these rows were all sprayed with potassium sulphide 1 oz. to 2 gals. water, six applications being given.

SUMMER TREATMENT.

This part of the work was divided into three series as was the work at Trumansburg. In Series I the work was begun very early, April 18; in Series II medium early, April 28; and in Series III late, May 9. Later applications were made May 23, June 5 and 15.

The various solutions used were:

Pottassium sulphide, 1 oz. to 2 gals. water.

[2]Soda-Bordeaux,—[3]soda (lye) 1 pound.
Copper sulphate 3 pounds.
Lime 5 oz.
Water 30 gals.

[4]Copper carbonate 1 pound, sodium carbonate (sal soda) ½ pound, enough strong ammonia to dissolve the copper carbonate, 50 gals. water.

Ammoniacal solution of copper carbonate,—copper carbonate 5 oz., ammonia 3 pints, water 50 gals.

Each of these solutions was applied to a separate row in Series I, II, and III.

The season was not favorable for the growth of mildew, a small amount appearing on the fruit, but none on the new growth. A very little of the disease was noticed June 15. The bushes made

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2 Halsted, B. D. Nineteenth Report New Jersey Experiment Station, p. 336.

3 "Babbitt's Potash or Lye" was used.

4 This remedy was recommended by Mr. David Allerton and Mr. J. A. Hepworth, of Marlboro, N. Y., who have used it successfully against mildew on American varieties, principally Houghton. There seems to be no reason from a chemical standpoint why sodium carbonate should be used.

a good growth considering the weakened condition they were in in the spring owing to previous serious attacks of the disease.

In all tests a check row was left for comparison. In Series I there was one row of each treatment and one check row set aside for the purpose of clipping off the mildewed tips as they appeared. The object was to determine whether or not it would pay to do this extra labor in a commercial plantation. It was necessary to drop this part of the experiment because no mildew appeared on the tips. A fair crop of fruit was marketed green the latter part of June.

RESULTS.

Table III shows the percentages of mildew from the various tests. Series IV is the part which received winter treatment.

TABLE III.— PERCENTAGE OF MILDEWED FRUIT IN GENEVA EXPERIMENT.

Fungicides.	Series I. Spraying begun very early. Six applications.	Series II. Spraying begun medium early. Five applications.	Series III. Spraying begun late. Four applications.	Series IV. Winter spraying and six applications of potassium sulphide, 1 oz. to 2 gals. water.
Soda Bordeaux — 1 to 10 formula....	1.3	.9	2.2	....
Ammoniacal solution of copper carbonate	2.3	1.2	3.2	....
Strong ammoniacal solution of copper carbonate plus sodium-carbonate.	1.3	1.5	1.8	....
Potassium sulphide, 1 oz. to 2 gals. water	3.5	1.8	3.	....
Checks	7.8	3.4	5.9	....
Copper sulphate, 1 oz. to 1 gal.......	...	...	...	3.9
Iron sulphate, saturated solution, plus 1 per cent. sulphuric acid	...	...	...	2.3
Soda Bordeaux — 1 to 5 formula	...	...	...	2.6
Ammoniacal solution of copper carbonate, 1 oz. to 5 gals. water	...	...	...	1.4
Ammoniacal solution of copper carbonate, 1 pound to 25 gals. water, plus sodium carbonate, ½ pound...	...	...	...	2.
Potassium sulphide, 1 oz. to 1 gal. water	...	...	...	2.9
Copper sulphate, 1 oz. to 1 gal.—check row with winter treatment only...	...	...	...	9.3
Check	...	...	...	16.5

In nearly every test this table shows very small percentages of mildew. With the winter treatment the ammoniacal solution of copper carbonate gave the best results, 1.4 per ct. of mildewed fruit where the check row had 16.5 per ct. The other winter treatments ranged from 2 per ct. to 4 per ct. The row which received the winter treatment only, 1 oz. copper sulphate to 1 gal. water, had 9.3 per ct. of mildewed fruit. This was 7.2 per ct. less mildewed fruit than its untreated row yielded, but was considerably higher than the percentages of the other check rows.

The percentages of the tests in the first three series are particularly low, varying from .9 per ct. to 3.5 per ct. and the checks from 3.4 per ct. to 7.8 per ct. The very best was soda-Bordeaux in Series II, .9 per ct., the next lowest was ammoniacal solution of copper carbonate in Series II with 1.2 per ct. The tests with potassium sulphide gave the highest percentages in Series I and II and second highest in Series III. The results with strong ammoniacal solution of copper carbonate were very favorable, being from 1.3 per ct. to 1.8 per ct.

In the results for this one year there was no gain derived from the winter treatment. The soda-Bordeaux and copper carbonate solutions gave slightly better results than potassium sulphide did, but these differences are not great enough to be of any significance.

RECOMMENDATION.

In Bulletin 133 potassium sulphide, 1 oz. to 2 or 3 gals. water, was recommended as the best remedy. The results of three years show that it is still the best fungicide the Station has thoroughly tested. Spraying should be begun very early just as the buds are breaking and continued at intervals of about ten days.

Further testing will be necessary to determine the relative merits of soda-Bordeaux mixture and the copper carbonate solutions in comparison with potassium sulphide solutions for checking gooseberry mildew.

THE NEW YORK APPLE-TREE CANKER.*

WENDELL PADDOCK.

SUMMARY.

Attention has but recently been called to this canker of apple trees, probably because the injuries were thought to be due entirely to sun scald.

Experiments extending through two seasons prove that this canker is caused by attacks of *Sphaeropsis malorum* Pk. (see p. 355), the fungus that causes the black rot of apple, pear, and quince fruits. The experiments also indicate that this fungus occurs on a number of other plants.

This disease is widely distributed in the orchards of the State as well as in those of adjacent States. In many instances it has been very destructive.

By way of treatment it is recommended: That the trees be kept in the best growing condition; that cankered limbs be removed where practicable; that the trees be sprayed with Bordeaux mixture as recommended on page 343; and that in some instances the trunks and larger limbs be scraped and washed as recommended on page 343.

CANKER.—WHAT IS IT?

The term canker, as applied to plant diseases, has been in use in Europe for a long time, where it is commonly used to designate the injury done to trees by species of *Nectria.* (See Plate

* Reprint of Bulletin No. 163.

XXXIII, fig. 2.) In fact the *Nectrias* have been associated with such injuries so long that in some instances the word canker has come to be regarded as a specific rather than a general term, but other species of fungi may cause a cankered condition of trees and plants. According to Hartig such wounds may be produced by the action of frost, when they are called frost cankers. In general, then, it may be said that any injury of trees, whereby a portion of the bark is destroyed and the wood laid bare may be classified under the general term, canker.

That the term canker, as applied to plant diseases, is new to many of our fruit growers may be due to the fact that the *Nectrias* are of but little economic importance in the United States.

THE NEW YORK APPLE-TREE CANKER.[1] — HISTORY.

Orchardists have been familiar with this diseased condition of the limbs of the apple tree for years. This is especially true with the Esopus Spitzenberg, where the injury to the limbs, commonly thought to be due entirely to sun-scald, has been associated with the apparent running out of this favorite apple. Attention was first called to the probability of this injury being caused by a plant disease by M. B. Waite, of the U. S. Department of Agriculture, Washington, D. C., in an article[2] that was read at the meeting of the Western New York Horticultural Society in 1898 and which appeared a few days later in the *Rural New Yorker*.[3] Mr. Waite suggested the fungus *Schizophyllum commune* Fr. as the probable cause of the disease. This article,

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[1] The name of New York Apple-Tree Canker is proposed for this disease for the purpose of distinguishing the canker produced by the attacks of the fungus *Sphæropsis malorum*, Pk. (see page 355) from cankers that are due to the action of other fungi, as the Pacific Coast Apple-Tree Canker and the European Canker.

[2] Waite. Proceedings Western N. Y. Hort. Soc., 1898, pp. 9, 10. A brief article, included in the report of the committee on botany and plant diseases, notes prevalence of an apple-tree canker in orchards of Western New York.

[3] Waite. Rural New Yorker, Feb. 5, 1898, p. 82.

together with notes[4] and a paper[5] by the writer, and a poster bulletin,[6] is the extent of the bibliography on the subject.

INVESTIGATIONS IN 1898.

In the spring of 1898 the Chapin Brothers, of East Bloomfield, N. Y., requested the Experiment Station authorities to investigate the cause of the dying of trees in their orchard. Prof. Beach visited the orchard and saw at once that a canker was the cause of the trouble, the serious nature of which was plainly evident in the numerous dead and dying trees. The writer was detailed to work on the subject, and the history of the investigations, extending through two seasons, is herewith presented.

The orchard in question originally consisted of one hundred and twenty-five acres. The trees on thirty of the eighty acres in one part were ruined by the canker and have been taken out, and the trees on one-half of the remaining fifty acres are now of little value. In the other part of the orchard originally consisting of forty-five acres, only about ten acres are left that are of much value. The owners have noticed the disease for the past six or eight years, but it has increased very rapidly in the last three or four years. They have also found that it shows a decided preference for certain varieties, the Twenty Ounce being the most susceptible; then the Baldwin, Wagener, Greening and King follow in the order named. The Tallman Sweet appears to be practically free from the disease. Trees growing in low land or in any situation where the ground was at all wet, were found to suffer

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[4] Paddock. Science, 8: 596. An Apple Canker. Brief account of investigations, and concludes that the disease is probably caused by the fungus *Sphæropsis malorum*, Pk.

—— P. 836. Additional Notes on an Apple Canker. Notes the occurrence of a *Sphæropsis* on pear and quince trees, and as causing a twig blight of apple trees.

[5] Paddock. Proceedings of the Western N. Y. Hort. Soc., 1899, pp. 58–64. An Apple Canker. Popular account of investigations with the disease.

[6] Vermont Special Bulletin, April, 1899, gives illustrations of cankered apple-tree limbs.

most, while the trees in the outside rows were noticeably freer from the canker than those in less exposed situations.

It has been argued by some persons that the trees, now forty years old, have reached the limit of their usefulness and are dying of old age. However, those trees that are free from canker are in a very vigorous condition, and the fact that cankered limbs occur on much younger trees in widely separated localities and in the best orchards, tends to disprove this theory. Neither can the trouble in this case be attributed to neglect, unless it be in the matter of spraying, since the orchard has received from the beginning practically the same culture that is advocated by our best authorities of to-day. Sixteen years ago the orchard was thinned by taking out each alternate diagonal row of trees. The elder Mr. Chapin was one of the first to spray with insecticides, but the all important point, as it now appears, spraying with Bordeaux mixture, has been neglected. An apparent contradiction to this statement is found in an old orchard not a quarter of a mile distant, that has never been sprayed and has been in sod for years, yet there are very few cankered limbs in any of the trees. It may be mentioned, however, that this orchard is located on a different slope of land and on poorer soil. The soil of the Chapin orchard is for the most part deep and rich and has produced a vigorous growth so that now the trees are very large.

Severe and unintelligent pruning has also been given as the cause of the presence of canker in this as well as other orchards. While it is admitted that misuse of any kind may favor the development of the canker fungus indirectly, yet the answer to the specific statement is found in the fact that unpruned seedling apple trees are found in wood pastures that are badly attacked by the canker fungus.

In the preliminary studies of the canker certain large, dark colored spores were found, which were at the time supposed to come from some saprophyte; however, cultures were made from them. Agar plate cultures were also made from the diseased

bark, by taking small particles from the inner bark with sterile instruments. Two forms of fungi appeared in these cultures more or less constantly, which led to their being separated and transferred to sterilized bean stems in test tubes. Here they grew luxuriantly and soon produced fruit, the one form producing the familiar dark colored spores which were not at that time identified, while in the other the sporophores of *Schizophyllum commune* Fr. were formed.

Inoculations were made with the cultures on June 22 on seedling apple trees in the nursery row as follows: Three trees were inoculated with material from cultures of the dark spored fungus, three trees with material from cultures of *Schizophyllum commune,* and three trees were punctured but not inoculated to serve as checks. The inoculations were made by cutting a small opening in the bark with a sterilized knife and inserting a small amount of the material from the bean stem cultures between the bark and wood. All of the punctures were covered with filter paper which was kept moist for about thirty-six hours. On the same date two inoculations with each of the two cultures, together with check wounds, were made in the larger limbs of a mature apple tree. These inoculations were not moistened or protected in any way. In two weeks' time there was an area of discolored bark around each place of inoculation where the unknown fungus had been inserted. The other inoculations as well as the checks showed no signs of growth and the wounds soon healed.

As soon as it was known that the one fungus could penetrate living bark under certain conditions more inoculations were made. July 6, six young seedling apple trees in the nursery row and three limbs of a large apple tree were inoculated with the dark spored fungus, six seedling nursery trees and three limbs of a larger tree with *Schizophyllum commune,* while three seedling nursery trees and three limbs of a large tree were punctured but not inoculated to serve as checks. The inoculations made in the seedling trees were all protected with filter paper as before, but

those made in the larger tree were unprotected. The dark spored fungus grew at all points of inoculation, while all of the other wounds soon healed.

On July 11 an effort was made to imitate the scars that are found in the outer bark that are mentioned on page 339. Small pieces of the outer bark were cut from two small areas on separate limbs of a large tree which were inoculated with the dark spored fungus, making twenty-eight inoculations in all. Two similar areas were inoculated with *Schizophyllum commune* and two areas were prepared but not inoculated to serve as checks.

Ten inoculations with the dark spored fungus, two with *Schizophyllum commune* and two check wounds were made by cutting through to the wood as before. All inoculations and check wounds were kept moist with damp filter paper. The dark spored fungus grew at all points of inoculation producing deep wounds or cankers where the incisions were made through to the wood as is shown in Plate XXX, fig. 3. Fig. 1 of the same plate shows the effect of the inoculations where small pieces of the outer bark were removed. The fungus was unable to penetrate to the cambium and made only small surface wounds, as may be seen in the illustration. The pieces of bark have been removed on one side leaving scars which resemble those that occur on cankered limbs as in Plate XXX, fig. 2.

On the same date, July 11, four inoculations were made with each of the two cultures in the larger limbs of a pear tree and four of each in the larger limbs of a quince tree. The inoculations, together with check wounds, were kept moist with damp filter paper as before. The dark spored fungus grew at all points of inoculation on the pear tree, but did not grow on the quince. All of the inoculations with *Schizophyllum commune* together with check wounds soon healed.

These experiments showed conclusively that the dark spored fungus can penetrate living apple-tree bark under certain conditions and produce a cankered condition of apple-tree limbs and also indicated that it may produce a diseased condition of pear-tree bark.

On the other hand it is evident that *Schizophyllum commune* Fr. cannot penetrate living apple-tree bark and it is quite probable that the same is true of pear-tree bark. The result of the inoculations on the quince cannot be regarded as conclusive because of the small number of inoculations made; but numerous inoculations made in the spring of 1899 showed that the dark spored fungus can produce a cankered condition of quince limbs when inserted under the bark.

The stress of other duties during the growing season prevented any study into the nature of the canker fungus and nothing further was done until fall when cultures of the fungus were shown to Mr. F. C. Stewart, the Station Botanist. He at once noted a strong resemblance of the dark spores to those of the black rot of the apple, *Sphaeropsis malorum* Pk., and suggested that it might be that disease. Mature apples were at once inoculated with material from the test tube cultures that had been obtained from cankered apple-tree limbs. In twenty-four hours decay had begun around the points of inoculation and in sixteen days pycnidia and mature spores of *Sphaeropsis* were found on all inoculated apples. The check apples which were punctured but not inoculated and kept under the same conditions remained sound. This experiment was repeated many times and the results were always the same.

Now that it was known what to look for an examination of cankered limbs in the orchard revealed the presence of an abundance of small, dark, fungus pustules or pycnidia on the brown and shrunken areas of dead bark. Fig. 3 of Plate XXVIII is a larger view of the smaller canker shown in Fig 1 at *b*. An examination of the bark on the older portion of the cankered area reveals the presence of numerous pycnidia in which the dark colored spores, that have been frequently mentioned, are borne. They are shown natural size in Fig. 4, which is a small section of the dead bark from the same canker. It will be seen that the pycnidia are abundant and large enough to be easily found.

Pycnidia containing mature spores were also found to be abundant on the dead bark surrounding the points of inoculation that were made from the cultures of *Sphaeropsis*. Plate XXX, fig. 3, is from a photograph of one of the limbs of an apple tree as it appeared at the close of the present season, that was inoculated in the spring of 1898 with cultures made from a cankered limb. Pycnidia are numerous on the surface of the bark and on the decorticated wood as well.

The result of over fifty inoculations made from cultures that were obtained from cankered apple-tree limbs prove that the apple-tree canker of New York apple orchards is caused by a fungus of the genus *Sphaeropsis*. In every instance where the incisions were made through to the wood, typical cankers were produced and mature fruit of the *Sphaeropsis* formed on the decaying bark and in some instances on the decorticated wood also. The inoculation experiments were repeated many times during the season of 1899 and the results have been the same.

GEOGRAPHICAL DISTRIBUTION.

A personal examination of a great many orchards during the past two seasons reveals the fact that this canker of apple trees is widely distributed in the orchards of New York. In fact an orchard is rarely seen that is entirely free from the disease. As is to be expected, however, it is more abundant in some localities than in others, and as has been previously mentioned, some varieties are more subject to the disease than others. It is specially injurious in many of the apple growing sections of western New York.

Responses to a circular letter sent to the authorities of the various experiment stations, together with personal examinations, bring out the positive information that this canker occurs in Connecticut, Indiana, Maryland, Michigan, Pennsylvania and Vermont, and that it probably occurs in Illinois, Maine, Massachusetts, Minnesota, New Jersey, West Virginia and portions of Canada. It seems probable that when the disease becomes more

generally known it will be found in many of the apple growing sections of the northern, central, and New England states.

APPEARANCE OF CANKERED LIMBS.

When one approaches a diseased tree his attention will be attracted to the dark and enlarged sections of the larger limbs. A closer examination shows that the bark is much roughened as well as thickened, and in many instances a portion of the wood is laid bare. The decaying bark and wood offer a convenient lodging place for borers and fungi which aggravate the injury and add to its unsightly appearance. The dead bark on many of the diseased limbs clings tenaciously to the decaying wood, which is a feature that distinguishes this canker from sun scald, since with the latter trouble usually the first symptom to be noticed is the peeling of the bark from the injured surface. The area of bare wood is often small as compared to the extent of swollen bark; limbs are frequently seen that for six feet or more of their length are covered with rough bark. The progress of the disease on such limbs may be marked by numerous pits or scars, showing where the fungus was able to live until perchance it gained entrance to the cambium through some injury, when a serious wound was the result. These scars are usually circular in form and may be outlined by two or more concentric lines. An example of this form of the disease is shown in Fig. 1 of Plate XXIX, where for more than six feet of its length the limb is covered with the rough bark or the scars where the bark has become detached. The fungus has only reached the cambium and formed a canker at *a*. Fig. 2 of Plate XXX is a larger view of a section of the same limb showing the scars more in detail.

Other instances occur, where, though the bark is much swollen and roughened, the fungus has not been able to penetrate to the cambium, but has died after a time leaving the scars of its attack, aside from which the limb has regained its normal condition.

The fungus shows a preference for the larger limbs of mature trees. Small limbs and young trees are much less frequently

attacked, though the trunks and branches of the latter are sometimes badly injured, and twigs of the current season's growth may suffer serious injury from attacks of the fungus. Twenty Ounce apple trees are apparently the exception, since in some localities the trunks of this variety are badly injured. The fungus extends down from diseased branches or from canker spots at the forks of the tree till in aggravated cases large areas of bark are destroyed exposing the wood in ugly wounds. These patches of black, decaying wood are conspicuous from a distance. Old age and neglect, or a lack of vigor from any cause evidently favor the disease though apparently thrifty trees are frequently ruined by its attack.

The effect of a canker on a limb depends on the amount of bark that is injured or destroyed. In severe cases the disease may extend entirely around a limb, thus effectually girdling it. Thus it occasionally happens that the leaves on some part of a tree shrivel and die without apparent cause, but a close examination shows the presence of rough, dead bark somewhere on the limb, indicating the presence of the canker fungus which has extended around the limb and cut off the flow of sap.

Plates XXVIII and XXIX are reproduced from photographs of typical cankered limbs. In Fig. 1 of Plate XXVIII the characteristic rough bark is shown and at *a* the wood is exposed, the white fruiting bodies of the fungus, *Schizophyllum commune* Fr., being conspicuous on the dead bark. At *b* is a canker spot of comparatively recent formation. Fig. 2 shows the same limb from which the dead bark has been removed; only a narrow strip of live bark remained that kept the limb alive. Fig. 3 is an enlarged view of the more recent canker shown in Fig. 1 at *b*. This canker is evidently of three seasons' growth as is indicated by the three series of concentric lines, now rather indistinct, that at one time separated the dead from the living bark. The extent of the current season's growth can be readily distinguished by the smoother appearance, while a distinct line separates the dead from the living bark.

In some instances cankers occur quite uniformly on the southwest side of the trees, thus indicating that they had their origin in injuries produced by sun scald. The work of the fungus may be recognized by the thick rough bark, while the fruiting pustules reveal its presence where it is still or has recently been in an active condition.

EXTENT OF INJURY.

The extent of the injury done to the orchards of the State can scarcely be estimated, but it is safe to say that this canker is one of the worst diseases with which the orchardist will have to contend since it attacks the tree directly instead of the foliage and fruit as is the case with the majority of our orchard diseases. The appearance of the cankers is such that their injurious nature may not be apparent to the casual observer until his attention is attracted by the shrivelling of the leaves; thus the tree may be ruined before it is realized that anything serious is the matter. In one instance the loss of a large acreage of orchard was due to the attacks of the canker fungus (see page 333) and in a great many orchards it has done serious damage.

TIME AND MANNER OF INFECTION.

Infection takes place in the spring of the year as is shown by the growth that the fungus makes in the bark. The presence of the fungus in a newly infected limb is first indicated by a small area of discolored bark. This area extends slowly as the fungus grows outward in all directions till mid-summer, when a definite boundary forms between the dead and living bark, thus showing that growth for the season has stopped. This season's growth had stopped by the first of August, and in some instances pycnidia containing mature spores were found at that time on bark where infection had taken place in the spring.

Many of the spores remain in the pycnidia till the following spring, or longer, when they are given off and disseminated. The mycelium is unable to penetrate to the cambium through living

bark, but those spores that chance to fall and germinate in a wound, produce the cankers. Other spores are deposited on limbs that have an abundance of dead and decaying outer bark where they find conditions suitable for growth. In such instances no direct injury is done to the tree, but spores are produced and disseminated so that a constant source of infection is maintained. The spores possess great vitality since some of them germinate after having been kept a year in the laboratory.

In some instances the mycelium apparently lives over winter and continues its growth the following spring. The formation of the largest cankers can scarcely be explained in any other way. However, in all of the inoculations made in the spring of 1898, in only one instance did the resulting canker enlarge any during the present season. See Plate XXX, fig. 3.

DOES THE MYCELIUM PENETRATE THE WOOD?

This question is suggested by the presence of two or more cankers on the same limb, the external appearance of the more recent ones suggesting the possibility of the fungus having passed from the old canker through the wood and appearing on the surface of the limb at favorable points where the newer cankers were formed. An examination of a number of specimens and the occurrence of pycnidia on decorticated wood shows that while the mycelium does penetrate the wood to some extent, the fact is of little economic importance. One limb was examined that had five small cankers on it at intervals of about a foot. On splitting the limb it was found that the mycelium had penetrated the wood at but one point and that for only a short distance.

PREVENTIVE MEASURES.

Although experiments in treating this disease are under way no results have yet been reached and from the nature of the fungus it will be seen that a number of years must elapse before data

can be secured from which definite conclusions may be drawn. However it is a matter of common observation that in the majority of instances the disease is not nearly as prevalent in orchards that have been well sprayed with Bordeaux mixture for several years past as it is in those that have not been sprayed. Judging from the success with which many other plant diseases are combated it is reasonable to expect beneficial results to follow systematic spraying with Bordeaux mixture as a preventive of the canker.

In localities where canker is abundant special attention should be paid to the sanitary condition of the trees. Perhaps one of the most important considerations is to see that the trees are not crowded and that they are pruned so as to admit sunshine and a free circulation of air. The old bark is not shed as freely from the limbs and trunks of trees that are densely shaded and the moisture collecting in this bark is not easily dried out; thus faculative parasites like the canker fungus as well as saprophytic fungi find congenial surroundings.

The practice of scraping and whitewashing the trunks and branches of fruit trees has largely fallen into disfavor, but it is certainly a commendable practice and should be adopted in localities where canker is severe. However, washes that are less conspicuous and equally, if not more effective, than whitewash are now recommended; the following formula has been satisfactory to some orchardists:

WASH FOR TREE TRUNKS.

Whale oil soap	1 pint.
Slaked lime	3 pints.
Water.	4 gallons.
Wood ashes	To thicken as desired.

Dissolve the soap in hot water, then stir in the lime. When the ingredients have been reduced to a smooth state by stirring dilute with water to four gallons, then stir in wood ashes till the wash is of the desired consistency.

Other formulæ equally as good as the one given are in use, but

the important ingredients in most of them are the same as in the one given above.

These washes probably have the effect of softening and loosening the old bark so that it is more readily shed, thus relieving the bark bound condition and inducing a vigorous growth. Bordeaux mixture is beneficial in this respect as a smooth, shiny appearance of the bark is a characteristic of well sprayed trees.

A discussion of the necessity of thorough cultivation and fertilization of orchards need not be entered into here, but it may be said that any treatment that tends to promote the vigor of the trees indirectly gives them greater power to resist disease. This fact was strikingly illustrated in the inoculation experiments with nursery stock where it was found that the trees that were making a feeble growth were far more susceptible to the action of the fungus than those which were making a vigorous growth.

Usually but little attention is given to slight wounds that are made here and there on the trees, but it should be remembered that a majority of cankers start from some mechanical injury. Too much care cannot be exercised not to wound or bruise the limbs when trimming the trees or picking the fruit. Wounds are frequently made by the chafing of ladders against the limbs or by the workman's boot when climbing through the trees. Serious wounds are also frequently made by propping the limbs when they are overloaded with fruit. The props should be padded or have the corners rounded where they come in contact with the limbs; they should be put in place carefully and not be driven under the limbs as is sometimes done. All wounds, whether accidental or made in trimming, should be protected with thick paint or grafting wax.

Cankered limbs should be cut out wherever practicable, or in some cases it may pay to cut off the diseased bark and cover the wounds as recommended above. Then as a preventive measure we feel warranted in recommending thorough spraying with Bordeaux mixture, giving the first treatment before the leaf-buds

open in the spring, followed by the three sprayings that are usually given the trees for apple scab. Great pains should be taken to see that the limbs are thoroughly protected with the mixture as well as the foliage and fruit. The approximate dates of spraying may be given as follows: 1. About the time the leaf-buds begin to open. 2. About a week before the blossom-buds open. 3. As soon as all of the blossoms have fallen. 4. Ten days or two weeks after No. 3.

INVESTIGATIONS IN 1899.

It was originally planned that this season's work should be a verification of the previous year's results, namely, the identification of the canker fungus and the determination of its relation to what was thought to be the same species that occurs on pear and quince trees and on the fruit of all three species of trees. But the work broadened as *Sphaeropses* were found on a variety of hosts representing seven orders of plants.

Since a knowledge of the host plants of any plant disease is of great practical value in order that it may be successfully combated, an attempt was made to determine the relation of the species of *Sphaeropsis*, represented by the different hosts, to the canker fungus.

In the spring of 1898 specimens of blighted apple-tree twigs were received from Odessa, N. Y. It was not determined at the time what was the cause of the blight, but a subsequent examination revealed the presence of numerous pycnidia containing mature spores of a *Sphaeropsis*. On visiting the orchard late in the fall, it was found that the twig blight had been quite noticeable in 1897, but there was none to be found on the current season's growth. In all cases noticed, when once attacked, the entire growth of the season had been killed and in a few instances the disease had extended into the previous season's growth. There were a few miniature canker spots on the smaller limbs but none were noticed on the larger branches and the trees were in fairly vigorous condition.

Some pear trees growing in a door-yard about twenty-five rods distant from the orchard were pointed out as being in a dying condition, the top of one tree having been entirely destroyed while the other trees were half or two-thirds dead. The pycnidia of a *Sphaeropsis* were found to be very abundant on the dead bark, while a few black, shriveled pears that were still attached to the branches were attacked by the black rot fungus, *Sphaeropsis malorum* Pk.

A *Sphaeropsis* was also found on the twigs of a quince tree that grew by the side of the pear tree.

At a later date a canker was found on a quince tree in the Station orchards. The appearance of the cankers and their effect on the limbs was much the same as the canker of apple tree limbs, the swollen sections of limbs and the roughened bark at once attracting attention. The pycnidia of a *Sphaeropsis* were abundant on the dead bark where the fungus had recently been in an active condition. This fungus was also found to be abundant in the large quince orchard of Maxwell Brothers, near Geneva. There were but few typical cankers on these trees, but in many instances there was a well defined longitudinal strip of dead bark on the limbs on which pycnidia of a *Sphaeropsis* were abundant. It seems probable, however, that in such instances, as well as with the pear trees mentioned above, the fungus was following, but aggravating, former injuries.

Dilution plate cultures were made of the *Sphaeropses* from the twigs of the three different host plants and after the fungus had fruited, fruits of the apple, pear and quince were inoculated with pure cultures of the fungus from each of the three hosts. The fruits were kept in closed glass jars, the check fruits punctured but not inoculated occupying jars by themselves. Black rot, *Sphaeropsis malorum* Pk., was produced in each inoculated fruit while the checks remained sound. Usually there would be an area of decayed tissue around the points of inoculation in twenty-four hours, depending on the degree of ripeness of the

fruit. The decay progresses rapidly in the ripe fruit; in some instances the greater portion of the surface became brown, and mature spores of the fungus were formed in six days.

In the spring of 1899 a *Sphaeropsis* was found on dead and dying Japanese plum trees at Riverhead, N. Y. Cultures were made of the fungus, and apple, pear, and quince fruits were inoculated. Black rot was again produced in the inoculated fruit while the check fruits remained sound.

These results led to an investigation of the local distribution of the genus *Sphaeropsis,* when it was found to be widely distributed; as the list of host plants given in Tables I and II will show. Cultures were made of the *Sphaeropses* from each host and apple, pear, and quince fruits were inoculated with cultures from each so far as the supply of fruit would permit. Three fruits at least, and in a majority of instances six, were inoculated with cultures from each host. Black rot was readily produced in the fruits, there being apparently no difference in the effect of the *Sphaeropses* as obtained from the different hosts. The inoculated fruits as well as the checks were kept in closed glass pars, as before.

During the progress of the work it was noticed that in most cases there was but little difference in the average size of the spores as they occurred on the different hosts. It was also found that when apple, pear, or quince fruits were inoculated with cultures of *Sphaeropsis* from these hosts the resulting spores were larger and of the size of those found on fruits attacked by black rot. The series of spore measurements given in the table below was made to show the relation of the average size of the spores to the host on which they are grown. Since spores of *Sphaeropsis* as they occur on any host vary greatly in size, even in the same pycnidium, an average of fifty measurements was taken in each instance.

Table I gives: (1) A list of hosts from which cultures of *Sphaeropsis* were made; (2) average length of 50 spores as they occur on the hosts; (3) average length of 50 spores as they occur

on apple, pear, and quince fruits when inoculated with cultures of *Sphaeropsis* from the different hosts.

TABLE I.— SPORE MEASUREMENTS OF SPHÆROPSES FROM DIFFERENT SOURCES AND ON DIFFERENT HOSTS.

Hosts from which cultures of Sphæropsis were obtained.	Average length of 50 spores as they occur on the host.	Average length of 50 spores produced on apple fruits inoculated with material from the different hosts.	Average length of 50 spores produced on quince fruits inoculated with material from the different hosts.	Average length of 50 spores produced on pear fruits inoculated with material from the different hosts.
Pear tree twigs	22	30	29	26
Quince tree limbs	23	29	29	27
Apple tree limbs	26	29	30	28
Japanese plum, Prunus triflora, Roxb.	28	30	30	30
Hawthorn, Cratægus oxyacantha, L.	21	28	..	..
Persimmon, Diospyros virginiana, L.	21	28	..	..
Wild crab, Pyrus coronaria, L.	21	28	..	..
Sumach, Rhus typhina, L.	23	29	..	..
Bitter sweet, Celastrus scandens, L.	22	..	..	..
Apricot, Prunus armeniaca, L.	22	30	..	..
Choke cherry, Prunus virginiana, L.	21	29	..	..
Hop horn beam, Ostrya virginica, Willd., decorticated wood	22	28	..	..
Mulberry, Morus alba, L.	21	..	..	..
European plum, Prunus domestica, L.	21	25	..	..
Elder, Sambucus canadensis, L.	21	29	..	..
Pear leaves	24	30	..	..

The table is of interest in that it shows that the average size of spores of *Sphaeropsis* varies according to the host on which they are grown. For instance the pycnidia and spores as they grow on pear wood are somewhat smaller than those that are found on apple wood, yet the spores produced on apple fruits inoculated with cultures from either host, are of the same size and character; similarly, though not shown in the table, when pear trees are inoculated with cultures of *Sphaeropsis* taken from apple trees the resulting pycnidia and spores are of the average size of those found in nature on pear tree bark.

The spore measurements also show that in most cases there is but little difference in the average size of the spores of *Sphaeropses*

as they occur on the hosts under consideration. Those on apple and Japanese plum trees are the only ones where the average length is noticeably greater than the rest in the list. Cultures of *Sphaeropsis* from either apple or Japanese plum trees when inoculated into apple, pear, or quince fruits produce black rot and as is shown in Table II these cultures grow interchangeably on at least four species of trees. In each instance the fruiting bodies resulting from the cross inoculations have the same characters as those that occur on the trees naturally.

Since cultures of *Sphaeropses* from the different hosts produce black rot of fruit, one apparently as readily as another, it was to be expected that the different cultures would make similar growths when cross inoculations were made in the trees. Accordingly, apple, pear, plum, cherry, and quince nursery trees were planted in a plat on the Station grounds for inoculation experiments.

Dilution plate cultures were made of the *Sphaeropses* from the different hosts and after spores formed, transfers were made to sterilized bean stems in test tubes. The inoculations were made by making a small incision in the bark with a flamed knife and inserting some of the pure cultures of the fungus from the test tubes between the bark and wood; then the wounds were covered with grafting wax. The work was done the last of May and first of June.

Table II gives the plan of the experiment together with the results; and shows: (1) Kind and number of trees inoculated and number of inoculations made in each tree; (2) source of cultures with which inoculations were made; (3) growth of fungus where inoculated.

TABLE II.—GROWTH OF SPHÆROPSIS FROM DIFFERENT SOURCES ON DIFFERENT HOSTS.

Hosts from which cultures of Sphæropsis were obtained.	Apple Trees.		Pear Trees.		* Plum Trees.		Cherry Trees.		Quince Trees.	
	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.
	6	Fair	5	Slight	4	Tree died	None of these inoculations successful.	....	4	Good.
	5	Slight	5	Slight	4	Very good		....	4	Slight.
Pear tree twigs	4	Slight	5	Good	4	Slight		....	4	Slight.
	4	Slight	5	Very good	4	Slight		....	4	Fair.
Check	4	0	4	0	4	0		....	4	0
	4	Slight	4	Fair	4	Slight		....	4	Good.
	4	Fair	4	Good	4	Slight		....	4	Slight.
Quince tree limbs	4	Fair	4	Good	..	....		....	4	Fair.
	4	Slight	4	Good	..	....		....	4	Good.
Check	4	0	4	0	..	....		....	4	0
	4	Fair	4	Fair	..	Fair		....	4	Fair.
Black rot of pear, Sphæropsis malorum, Pk.	4	Fair	4	Very good	4	Fair		....	4	Fair.
	4	Fair	4	Slight	4	....		....	4	Fair.
	4	Fair	4	Slight	..	....		....	4	Fair.
	4	Very good	4	Very good	..	Good		....	4	Fair.
	4	Very good	4	Very good	4	Good		....	4	Good.
Apple tree limbs	4	Very good	4	Very good	4	....		....	4	Good.
	4	Very good	4	Very good	..	....		....	4	Fair.

Check	4	0	4	0	4	0	None of these inoculations successful.	....	4	0
Japanese plum, Prunus triflora, Roxb.	4	Very good...	4	Very good ...	4	Good		....	..	
	4	Very good...	4	Fair	4	Slight		....	..	
Hawthorn, Cratægus oxyacantha, L..	4	Fair........	4	Fair	4	Very good		....	..	
	4	Fair........	4	Fair	..	....		....	..	
Persimmon, Diospyros virginiana, L..	4	Slight......	4	Slight	4	0		....	..	
	4	Slight......	4	Slight	4	0		....	..	
Wild crab, Pyrus coronaria, L.......	4	Fair........	4	Good	4	0		....	..	
	4	Fair........	4	Fair	4	0		....	..	
Check	4	0	4	0	4	0		....	..	
Sumach, Rhus typhina, L.	4	Fair........	4	Fair	4	0		....	6	0
	4	Fair........	4	Fair	4	0		....	..	
Bitter-sweet, Celastrus scandens, L...	4	Fair........	4	Fair	4	0		....	..	
	4	Fair........	4	Very good ...	4	0		....	..	
Apricot, Prunus armeniaca, L.......	4	Fair........	4	Slight	4	Tree died		....	..	
	4	Fair........	4	Slight	4	Fair		....	..	
Check	4	0	4	....	..	....		....	..	
Choke cherry, Prunus virginiana, L..	4	Good.......	4	Fair	4	Fair		....	..	
	4	Good.......	4	Fair	4	Tree died		....	..	
Hop hornbeam, Ostrya virginica,	4	Good.......	..	....	4	Very good		....	..	
Willd., decorticated wood	4	Good.......	..	....	4	Very good		....	..	

TABLE II — *Concluded.*

Hosts from which cultures of Sphæropsis were obtained.	Apple Trees.		Pear Trees.		* Plum Trees.		Cherry Trees.		Quince Trees.	
	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.	Each figure represents number of inoculations made in one tree.	Growth of fungus.
Mulberry, Morus alba, L.	4	Fair	..	....	4	Good	None of these inoculations successful.	....	..	
	4	Fair	..	....	4	Very good		....	..	
European plum, Prunus domestica, L.	4	Very good	..	....	4	0		....	..	
	4	Very good	..	....	4	0		....	..	
Elder, Sambucus canadensis, L.	4	0	..	....	..	....		....	..	
	4	0	..	....	..	....		....	..	
	4	0	..	....	..	....		....	..	
	4	0	..	....	..	....		....	..	

* Part European and part Japanese plum trees were used in the experiment; the inoculations were successful on the Japanese tree only.

The extent of growth of the *Sphaeropses* where inoculated has been expressed in the relative terms, slight, fair, good and very good. Figures 1, 2 and 3 of Plate XXXI are reproduced from a photograph of inoculated nursery trees of apple, pear and Japanese plum respectively, and show what has been termed a very good growth. Figure 4 of Plate XXXI shows a slight growth on an apple tree, while Fig. 5 is a check apple tree. The other two degrees of growth range between the two shown in the illustration.

Where the fungus made a very good growth it spread rapidly till the different inoculations coalesced and formed continuous cankers as is shown in the illustration. In some instances pycnidia formed by the tenth of July and by the first of August growth had stopped as could be seen by the formation of a definite boundary between the dead and living bark. Pycnidia were now abundant on the dead bark and occasionally on the decorticated wood under the grafting wax as well as elsewhere on the dead surface. In some instances where the fungus made a less vigorous growth the area of dead bark was entirely covered with the wax.

A number of the different cultures were inoculated into all four kinds of trees, all but three into both apple and pear trees, while all were inoculated into apple trees. Twenty-five sweet and twenty-five sour cherry trees, and twenty-five European plum trees were also used in the experiment, but none of the inoculations on these trees were effective. In all of the other inoculations there were but two entire failures. But the inoculations made with cultures of *Sphaeropsis* from cankered apple tree limbs made a greater growth than most of the others. Those made with cultures obtained from Japanese plum were the only ones which made a comparable growth.

The results of the inoculations on the pear trees are interesting from the fact that the cultures obtained from cankered apple tree

limbs made a greater growth when inoculated into pear trees than the cultures did that were made from diseased pear trees.

Various other inoculations were made that are not given in the table, the details of which need not be entered into here; it may be said, however, that of something over 1,000 inoculations made in 1899 very few gave negative results. Fig. 1 of Plate V shows an apple tree whose top is dead, the result of inoculations made with cultures of *Sphaeropsis* obtained from sumach. It should be pointed out, however, that this particular branch was making a feeble growth, and that inoculations made in two of the side branches failed to grow. In several other instances where inoculations were made in weak trees the fungus made a much greater growth than it did in adjacent vigorous trees. This point is of great practical importance and confirms what has been said on this subject on a former page. Fig. 2 of Plate XXXII shows a twig blight of pear and apple trees respectively, the result of inoculations made with cultures of *Sphaeropsis* from cankered apple tree limbs in twigs of the current season's growth.

The results of the inoculation experiments tend to show that the number of species of *Sphaeropsis* can be materially reduced. In some instances it appears that a new host has served as a basis for making a species, and since many of the hosts given in the table represent different species it would seem that this plan had been followed when some of these species were made. So far as the writer can determine there is but slight difference in the morphological characters of the species that are represented in the tables by the different hosts, such as might occur with any fungus when grown on different media or when transferred from one plant to another. Neither do the published descriptions of these species suggest any material differences.

A set of the *Sphaeropses* on the different hosts was submitted to Mr. J. B. Ellis, Newfield, N. J., for identification with the published descriptions. His determination of the species so far as he was able from the specimens sent are given in Table III.

TABLE III.— PRESENT CLASSIFICATION OF SPHÆROPSIS FOUND ON DIFFERENT HOSTS.

Pear tree twigs	Sphæropsis sp. Apparently same as on plum.
Quince tree limbs	Sphæropsis cydoniæ, C. and E.
Black rot of apple, pear, and quince fruits	Sphæropsis malorum, Pk.
Apple tree, bark	Sphæropsis mali (West.), Sacc.
Apple tree, decorticated wood	Sphæropsis cinerea (C. and E.), Sacc.
Japanese plum, Prunus triflora	Sphæropsis sp.
Hawthorn, Cratægus oxyacantha, L.	Sphæropsis demersa (Bon.), Sacc.
Persimmon, Diospyros virginiana, L.	Sphæropsis sp.
Wild crab, Pyrus coronaria, L.	Sphæropsis — New sp?
Sumach, Rhus typhina, L.	Sphæropsis sumachi (Schw.), C. and E.
Bitter sweet, Celastrus scandens, L.	Sphæropsis celastrina, Pk.
Apricot, Prunus armenica, L.	Apparently same as on plum.
Choke cherry, Prunus virginiana L.	Sphæropsis cerasina, Pk.
Hop hornbeam, Ostrya virginica, Willd. (decorticated wood)	Sphæropsis sp.
Mulberry, Morus alba, L.	Sphæropsis mori, Berlese.
European plum, Prunus domestica, L.	Same as on Japanese plum.
Elder, Sambucus canadensis, L.	Sphæropsis sambuci, Pk.
Pear leaves	Sphæropsis mali, West., foliicolous form.

A discussion of the relation of these species will be out of place at this time. However it may be pointed out that the inoculation experiments prove that the species occurring on apple-tree bark, *S. mali,* and on decorticated apple-tree wood, *S. cinerea,* are the same; also that these species are identical with the black rot fungus, *S. malorum.* Thus it will be seen that some interesting questions in nomenclature are involved. Which of these names should stand, if either, or whether they will all prove to be synonyms can only be determined after a careful study of the entire genus is made.

In former papers by the writer referred to on page 333 mention was made of the fungus, *Sphaeropsis malorum* Pk., as being the probable cause of the New York apple-tree canker. It is therefore suggested that this name be retained for the present in order that still further confusion in nomenclature may be avoided.

BODY BLIGHT OF PEAR TREES.

In the spring of 1898 when the preliminary studies with apple canker were begun a few inoculations were made in the larger

limbs of a pear tree with cultures of *Sphaeropsis* obtained from cankered apple-tree limbs. The details of the experiment are given on page 336. The fungus grew readily at all points of inoculation and though the culture material was inserted between the bark and wood it did not attack the cambium layer, but made its growth in the outer bark. Here dead sunken areas were produced similar to those that are so common on the trunks and larger limbs of pear trees. These definitely outlined and sunken areas of dead bark commonly known as body blight, have long been thought to be due to the action of the pear blight bacillus; however, there seems to be no definite reason for such belief.

But little attention was given the matter at the time since it was not then known that *Sphaeropsis* occurred on these blighted areas. In the spring of the present year, however, a *Sphaeropsis* was found to be comparatively abundant on the diseased bark of pear trees in the Station orchards. Since that time a large number of pear trees from many localities affected with body blight have been examined and in nearly every instance a *Sphaeropsis* was present though not in sufficient quantity to account for many of the blighted areas. *Macrophoma malorum* (Berk.) Berl. et Vogl. is commonly present in large quantities on the dead bark and since *Sphaeropsis* is able to produce body blight may not this closely related fungus be an important factor in producing the diseased condition?

Fifty successful inoculations made this spring with cultures of *Sphaeropsis* in mature pear trees confirm last year's results. An attempt was also made to grow the *Macrophoma* artificially, but it made an indifferent growth on all of the media that were tried and produced no fruit, consequently inoculation experiments with this fungus could not be undertaken at that time.

THE PACIFIC COAST APPLE-TREE CANKER.

After the publication of the paper, An Apple Canker, the writer received inquiries concerning the canker from the secretaries of

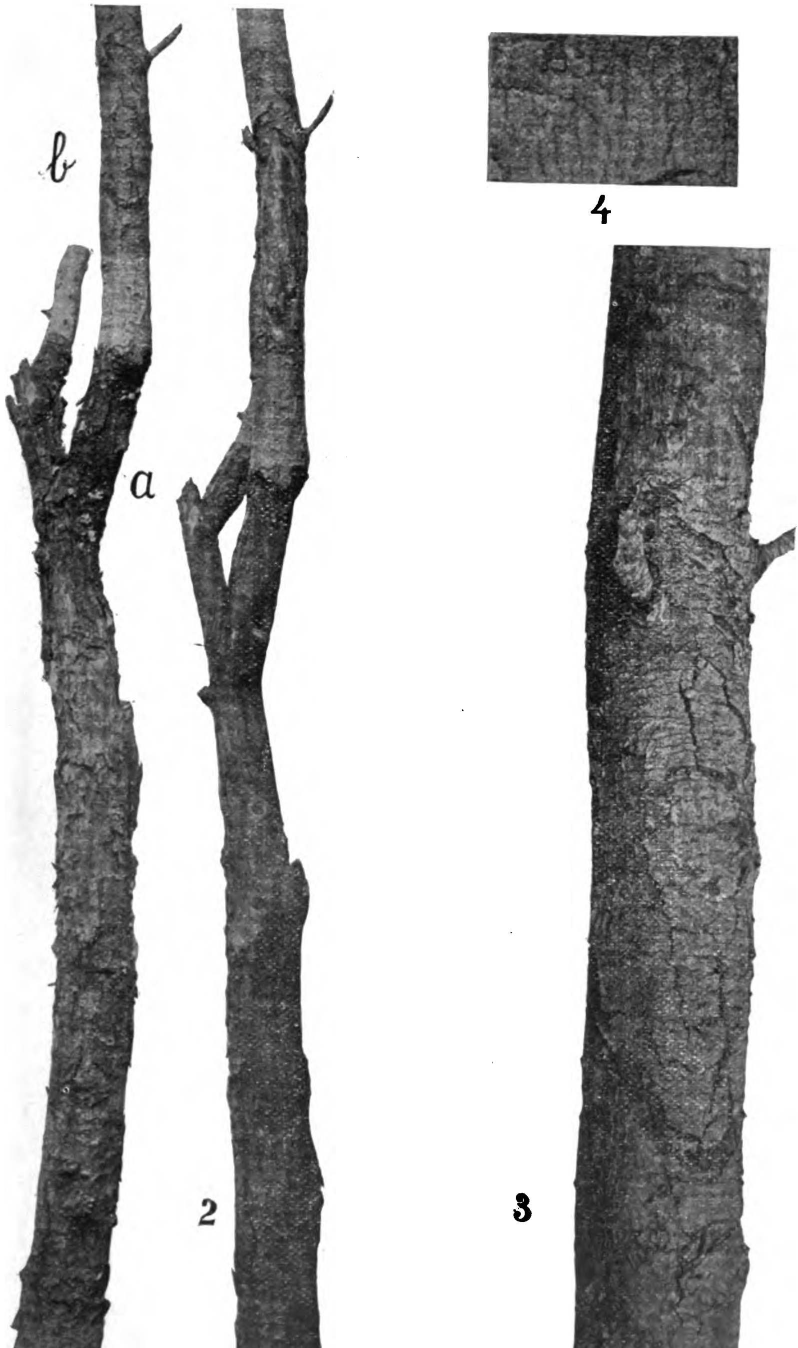

PLATE XXVIII.

Plate XXIX.

horticulture respectively of Oregon, Washington and British Columbia. These gentlemen sent specimens of diseased limbs which upon examination were found to be attacked by an entirely different fungus from the one that causes the New York canker, the spores were small, curved and hyaline while the spores of *Sphaeropsis* are large, oval and dark brown in color. A liberal number of specimens were received from each of the three sections and the fungus was the same in each case and so much in evidence that there can be little doubt but that it is the cause of the Pacific coast canker. Some of the specimens were submitted to Prof. C. H. Peck, State botanist, who pronounced the fungus to be a new species of *Macrophoma*. This disease because of its destructive nature has attracted a great deal of attention for a number of years in the Pacific Coast States, but no satisfactory method of combating it has yet been found. Since entirely different climatic conditions obtain in that part of the country it is not likely that the line of treatment recommended for combating the New York apple canker will be effective against this disease as it occurs on the Pacific coast.

Fig. 1 of Plate XXXIII is from a photograph of an apple-tree limb showing a typical specimen of the Pacific coast apple-tree canker.

THE EUROPEAN CANKER.

Fig. 2 of Plate XXXIII shows a canker on a quince tree limb which was produced by the fungus, *Nectria cinnabarina* (Tode.) Fr. This shows what is known as the tubercularial or conidial stage of the fungus; what appear as small white bodies in the picture scattered over the surface of the dead bark, are brilliant red or cinnabar colored stromata which bear the conidia or fruiting bodies of one stage in the life history of the fungus. It will be seen that the comparatively large size and brilliant color of the stromata render the fungus conspicuous so that it is not easily mistaken.

Another species, *N. ditissima,* is the common canker-producing fungus of the orchard trees in many parts of Europe. Neither of the species is sufficiently abundant in the orchards of the United States to be regarded as a pest.

The illustration in Plate XXXIII, fig. 2, is from a photograph of one of a few quince tree limbs attacked by *N. cinnabarina* that were found in the quince orchard of T. C. Maxwell and Brothers, Geneva, N. Y.

ACKNOWLEDGMENTS.

It is with pleasure that I acknowledge my indebtedness to Prof. Beach, at whose earnest request this work was undertaken, and to whose kind consideration its completion was made possible. To Dr. Thaxter I am indebted for advice on the question of nomenclature and to Mr. Ellis for the determination of species.

EXPLANATION OF PLATES.

PLATE XXVIII. Fig. 1.—*A cankered apple tree limb, wood exposed at* a *and white fruiting bodies of* Schizophyllum commune *Fr. are conspicuous on the dead bark. A canker of more recent formation is shown at* b.

Fig. 2.—*The same limb as in Fig.* 1 *with the dead bark removed.*

Fig. 3.—*A larger view of the small canker shown at* b. *The surface is thickly dotted with pycnidia.*

Fig. 4.—*Small section of dead bark from canker in Fig.* 3 *showing pycnidia natural size.*

PLATE XXIX.—*Different forms of cankers. Fig.* 1 *shows limb that for more than six feet is covered with rough bark, or scars where bark has become detached; fungus has reached cambium at* a.

2

3

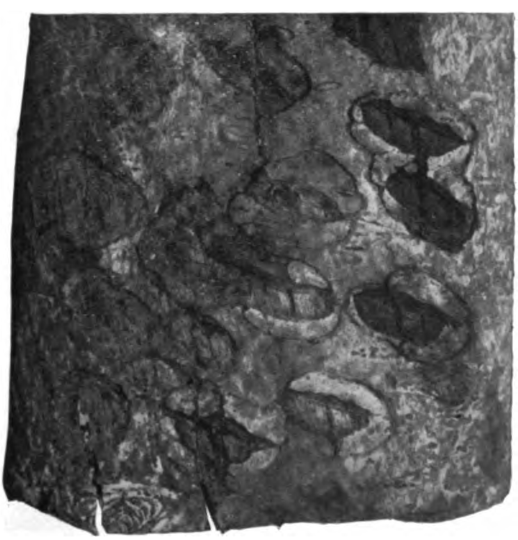

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PLATE XXX.

Plate XXXI.

PLATE XXX. Fig. 1.—*Apple tree bark inoculated with cultures of* Sphæropsis *from cankered apple limbs. Inoculations were made in the outer bark; the fungus was unable to reach cambium but made small wounds in the outer bark. Where the bark has been removed the scars resemble those shown in Fig.* 2.

Fig. 2.—*Section of limb shown in Plate XXIX, Fig.* 1, *enlarged to show scars more in detail.*

Fig. 3.—*Limb of a large apple-tree inoculated in spring of* 1898 *with culture of* Sphæropsis *from cankered apple tree limb. Photographed fall of* 1899. *The canker enlarged materially during the present season. Pycnidia of* Sphæropsis *are abundant on dead bark and decorticated wood.*

PLATE XXXI.—*Inoculation experiments with nursery stock.*

Fig. 1.—*Apple tree inoculated with cultures of* Sphæropsis *from cankered apple-tree limbs, showing what was designated "a very good" growth of the fungus.*

Fig. 2.—*Pear tree inoculated with cultures of* Sphæropsis *from cankered apple tree limbs, showing very good growth of the fungus.*

Fig. 3.—*Japanese plum tree inoculated with cultures of* Sphæropsis *from decorticated wood of hop hornbean. Very good growth of the fungus.*

Fig. 4.—*Apple tree inoculated with cultures of* Sphæropsis *from pear twigs, showing slight growth of the fungus.*

Fig. 5.—*Check apple tree; punctured but not inoculated.*

PLATE XXXII.— Fig. 1.—*Young apple tree, top branch killed by inoculating with cultures of* Sphæropsis *from sumach.*

Fig. 2.—*Twig blight of pear and apple respectively caused by inoculating with cultures of* Sphæropsis *from cankered apple tree limbs.*

Fig. 3.—*Quince inoculated with cultures of* Sphæropsis *from cankered apple tree limbs.*

PLATE XXXIII.— Fig. 1.—*Apple tree limb showing Pacific coast apple tree canker.*

Fig. 2.—*Quince tree limb showing canker caused by attack of* Nectria cinnabarina. *(Tode.) Fr.*

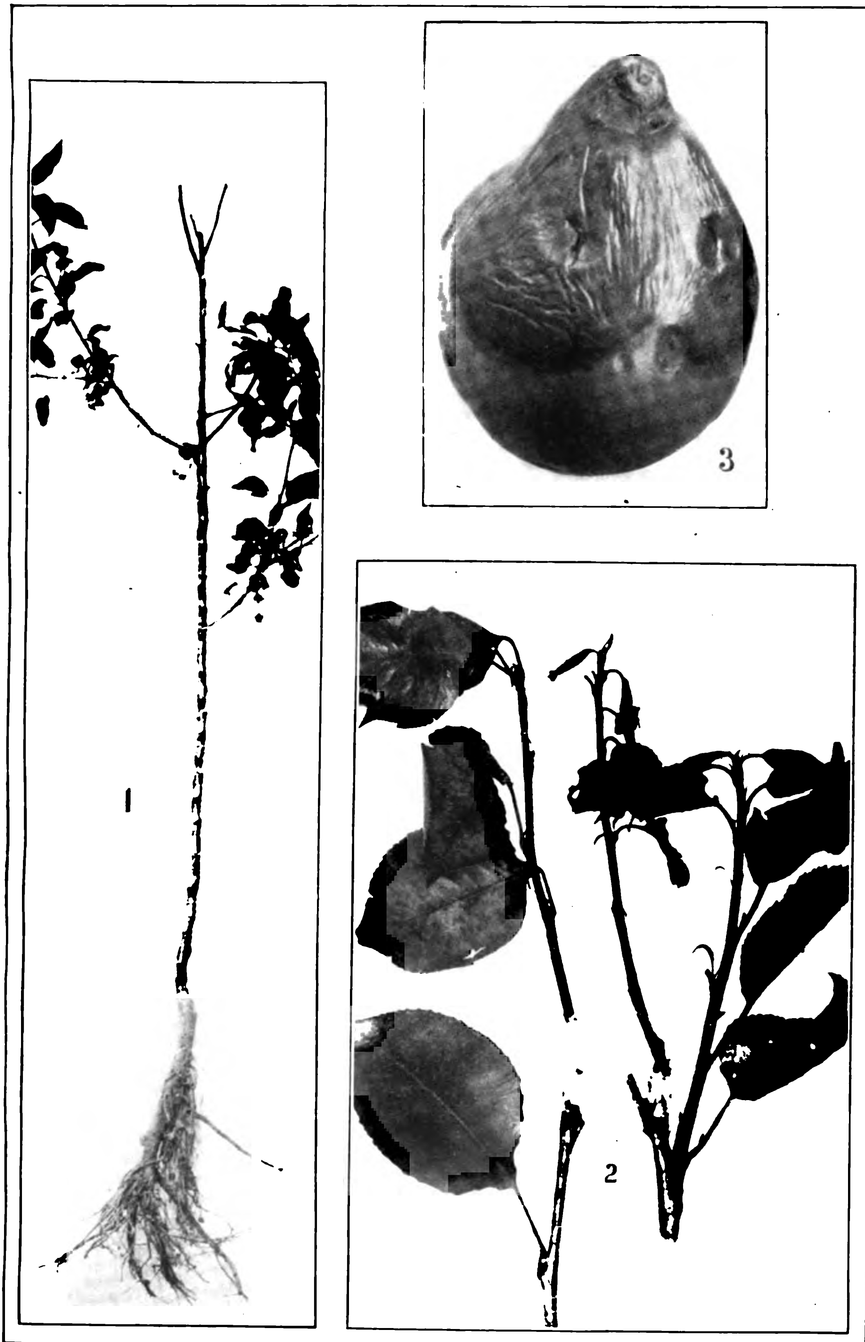

PLATE XXXII.

Plate XXXIII.

FERTILIZING SELF-STERILE GRAPES.*

S. A. Beach.

SUMMARY.

In Bulletin 157 were recorded the results of several seasons' work in testing the self-fertility of the grape. Lists were given of grapes which were perfectly self-fertile, partially self-fertile or self-sterile and completely self-sterile. Many of our cultivated American grapes belong in the last two classes and require cross pollination for formation of perfect bunches. The work of 1899 has been devoted to a study of the question whether some grapes are better than others for fertilizing the self-sterile kinds.

Prevention of accidental cross-pollination was secured by enclosing in paper bags the selected bud clusters of both the variety to be pollinated and that furnishing the pollen. Cross-pollination was effected by removing the pollinating cluster, when in blossom, from the parent vine and enclosing it with the cluster to be fertilized. The clusters were sometimes brushed together before enclosing, sometimes simply enclosed in the paper sacks and shaken, to distribute the pollen.

Twelve nearly or quite self-sterile varieties were treated with pollen from one or more of twenty-four varieties ranging from perfectly self-fertile to self-sterile. The results are given in the body of the bulletin, both in detail and summarized. The use of self-sterile varieties as pollinizers for other self-sterile varieties resulted in failure. Self-sterile varieties fertilized with varieties not strongly self-fertile produced clusters varying in compactness about as did the bunches of the pollinating variety. Self-fertile sorts, with rare exceptions, gave good results when used as fertil-

* Reprint of Bulletin No. 169.

izers for either partially self-sterile or completely self-sterile varieties. From study of the effect of pollen from different varieties upon the same self-sterile variety, it seems probable that failure to set fruit may be due to several causes, such as dropping off of blossom buds before they open or poor condition of the vine; but the most common cause is imperfect pollination due to impotent pollen.

Lists are given of varieties, both strongly self-fertile and imperfectly self-fertile or self-sterile, which blossom very early, medium early, in mid-season, medium late, late and very late.

INTRODUCTION.

In Bulletin 157 the writer presented a complete account, to that date, of the investigations on the self-fertility of the grape with which he had been engaged for several years.[1] It was therein shown that many of the cultivated varieties of American grapes are either self-sterile or very imperfectly self-fertile. Such kinds, when they are self-pollinated only, either bear no fruit or produce more or less imperfectly filled clusters. In discussing the practical bearing of these discoveries upon the selection of varieties and arranging them in vineyards so as to get the best results in fruit production, attention was called to the fact that self-sterile varieties may produce well filled clusters of fruit when the vines are located near enough to other kinds to make cross-fertilization possible. For this reason the general recommendation was made that whenever the self-sterile or the imperfectly self-fertile kinds are planted it would be well to put near them some other kind which blooms at the same time.

After Bulletin 157 was issued there came from several sources requests for more definite information concerning the mingling of varieties so as to provide for the proper fertilization of those kinds which cannot produce well filled fruit clusters unless they are

[1] Beach, S. A. Self-fertility of the Grape. N. Y. Agr. Exp. Sta. Bul. 157. Dec., 1898.

cross-fertilized. This brought up the question whether some grapes are better than others for fertilizing the self-sterile kinds or whether any variety other than the one to be fertilized will answer the purpose if it blooms at the same time. Similar questions, in one form or another, are apt to arise wherever American grapes are cultivated.

Scarcely any definite information on this subject could be found. Being a subject of considerable practical importance to viticulturists, arrangements were made to begin the investigation of it in 1899. The results of the first season's work in this line are set forth in the following preliminary report of the investigation.

WORK FOR 1899.

PLAN.

Twelve varieties which were selected because they are nearly or quite self-sterile, were artificially cross-pollinated in the manner hereafter described. Twenty-four kinds of grapes were tried as fertilizers for these varieties. Most of them were self-sterile or nearly so, others fully self-fertile, and still others intermediate between these two extremes. The twelve varieties which were artificially cross-pollinated were not emasculated. For the purpose of preventing accidental cross-pollination by means of insects or otherwise, the clusters to be tested were enclosed in paper bags before the blossoms opened, and were kept thus covered during the entire blooming season except the few minutes when the bags were opened to introduce the clusters which furnished the pollen for the test. The clusters which were selected to furnish the pollen were likewise covered before they came into blossom and were kept covered, even after they were removed from the vine which bore them, until they were applied to the self-sterile variety upon which their pollen was to be tried. The bagging of the clusters was done after the manner illustrated and described in Bulletin 157. By thus protecting all of the blossoms which were used in

the tests, the chances of accidental cross-pollination were reduced to a minimum.

After the blossoming season had passed, a record was made to show which clusters had set fruit and which had failed to set fruit. When the fruit was ripe each cluster under test was rated on the scale of 100, according to the percentage of a full cluster which was found. A perfectly formed cluster was rated 100, a half-filled cluster was rated 50 and others were rated in a corresponding manner.

LOCATION OF THE VINEYARDS.

The tests were conducted in 1899 in three quite widely separated localities: In the Station vineyards at Geneva; in the vineyards of E. Smith & Sons at Highlands, on the east bank of Seneca lake, near Lodi; in the vineyard of Mr. E. C. Gillett, Penn Yan, N. Y. Our acknowledgments are due the gentlemen who have consented to allow the experiments to be conducted in their vineyards, and also to Mr. Horace W. Gillett who assisted in the work at Penn Yan in a very careful and satisfactory manner.

The Highlands vineyards are on soil which is derived largely from broken shale. The other vineyards mentioned above are on clay loam.

CROSS-POLLINATION.

The cross-pollinating was done at Highlands, June 12. At Penn Yan it was done June 12, with the exception that Brighton and Salem were crossed each upon the other June 13. At the Station the work of cross-pollinating was done at convenient times during the blooming period from June 10 to 15.

The cross-pollinating which was done at Highlands was under the direction of C. P. Close. The plan there followed was to uncover the cluster which was to receive the pollen. The cluster selected to supply the pollen was then taken from the bag in which it had till this time been kept, and fastened to the first mentioned cluster. Both clusters were then covered with the bag

which had held the cluster which furnished the pollen. After the bag had been closed and labeled, it was shaken so as to agitate the loose pollen which it might contain and possibly assist in more thoroughly distributing it among the open flowers of the cluster which was to be pollinated.

In the Penn Yan tests and in those at the Station, in addition to the treatment above outlined, the open flowers of the cluster which were selected to supply the pollen were brushed over the open flowers which were to be cross-pollinated before fastening the two clusters together. With most varieties the interlocking of the branches of the two clusters was sufficient to hold the loose cluster in place, but in some instances it was necessary to tie the two together. Judging from their appearance when the bags were opened after the blooming season had passed, the flowers of the detached clusters which were not open when the bag was finally closed and labeled, generally failed to open later. It appears, therefore, that the pollen which effected the fertilization of the flowers as shown by the later development of fruit, must have come almost entirely from blossoms which were open when the hand pollinating was done. With some of the varieties which were artificially cross-pollinated after the manner above described, a considerable portion of the flowers were not opened when the hand pollination was done, and probably did not open for a period of from 24 to 48 hours thereafter. Had the bags been reopened on each of the two days following the one upon which the hand pollinating was done, and the clusters brushed again with freshly opened blossoms, the result might have given a more accurate indication of the kind of clusters which such varieties may be expected to produce when they stand adjacent to each other, and the process of cross-pollination goes on freely during the entire blooming season.

On the other hand it should be observed in this connection that, even with varieties which had not come into full bloom when the hand pollinating was done, some perfectly filled clusters were obtained, showing that the percentage of blossoms which became

cross-pollinated was, under the circumstances, remarkably large. Take, for example, the results with Brighton fertilized by Catawba. Both at Highlands and Penn Yan these varieties had a large percentage of unopened blossoms when the Catawba clusters were applied to the Brighton. Eight Brighton clusters at Highland were thus supplied with Catawba pollen and all of them set fruit. When the fruit was ripe one cluster ranked 95, one 90, one 85. The two lowest were rated 55 and the average rating was 74.4. At Penn Yan five Brighton clusters were likewise supplied with Catawba pollen. One cluster so treated ripened but four fruits, one was almost perfectly filled and the remaining three were well filled. Omitting the first named cluster, the average rating was 97.5; including it the average was 80. While, as has been said before, these averages cannot be taken as indicating with strict accuracy the efficiency of Catawba as a fertilizer for the Brighton, they show that, even under the most unfavorable conditions which obtained in these trials, a surprisingly large proportion of the blossoms became cross-pollinated. In all cases where the number of clusters under experiment is large enough to give some indication of the value of the variety as a fertilizer for self-sterile sorts the results with the different varieties may be looked upon as comparable, because the treatment was similar in all the tests with the exception that in the Highlands vineyard the clusters to be cross-pollinated were not brushed with the cluster selected for furnishing the pollen, but the two kinds of clusters were simply inclosed in the bag and shaken together.

COVERING THE CLUSTERS.

As has already been stated, all of the clusters which were used in these experiments were covered before the blossoms opened, using paper bags for this purpose after the manner described in Bulletin 157. This work was largely done before the varieties commenced to bloom. The clusters in the Highlands tests were bagged June 7 and 8; with few exceptions those at Penn Yan were bagged June 9; and those at the Station were bagged at various

times from June 5 to June 10. In a few cases the variety had begun to bloom before this work was done. Great care was then taken that no cluster with an open blossom should be bagged.

THE BLOOMING PERIOD.

At Highlands the following observations on the blooming varieties were made in forenoon of May 8:

Aminia — Beginning to bloom.
Brighton — None in bloom; probably will not begin to bloom before June 12.
Catawba — Ditto.
Niagara — Not many blossoms open.
Worden — Nearly half in bloom.
Wyoming — First blossoms opening.

On Monday, June 12, when the cross-pollinating was done, Aminia was in some cases nearly out of bloom. Brighton was hardly enough advanced in bloom to furnish an abundant supply of pollen. With these exceptions no difficulty in finding clusters in good condition for the cross-pollinating was noted.

At Penn Yan the following notes on the condition of bloom were made when the cross-pollinating was done June 12:

Brighton — Many clusters have no open blossoms, but the majority of clusters have at least begun to bloom.
Catawba — About the same stage of advancement as Brighton.
Eldorado — Nearly in full bloom.
Herbert — Past full bloom and going out of bloom.
Lindley — Most clusters are coming into bloom; a few have not yet begun to bloom.
Merrimack — Nearly in full bloom.
Salem — Past full bloom and going out of bloom.
Niagara — Nearly in full bloom.
Worden — Nearly in full bloom.

The period of bloom in 1899 of the varieties which were under test at the Station is shown in the following table. The first date shows the opening of the first blossoms, the second date shows when the variety reached full bloom and the last date shows when the last blossoms were seen.

TABLE I.—PERIOD OF BLOOM IN 1899 OF EXPERIMENTAL VARIETIES IN THE STATION VINEYARD.

Location		Name.	Period of bloom.		
Vineyard.	Row.		First bloom.	Full bloom	Last bloom.
8..	13	Aminia	June 9	June 12	June 15
8..	22	Barry	June 8	June 12	June 15
8..	6	Black Eagle	June 13	June 15	June 20
8..	24	Black Eagle	June ?	June 14	June 20
11..	20	Black Eagle	June 10	June 13	June 16
8..	7	Brighton	June 12	June 14	June 18
11..	19	Brighton	June 9	June 11	June 15
11..	23	Catawba	June 7	June 9	June 15
11..	26	Catawba	June 8	June 11	June 15
8..	4	Columbian Imperial....	June 7	June 10	June 13
11..	17	Columbian Imperial....	June 7	June 9	June 11
8..	7	Creveling	June 10	June 13	June 15
11..	16	Eaton	June 9	June 11	June 13
11..	25	Eaton	June 7	June 9	June 13
8..	8	Eldorado	June 13	June 15	June 19
11..	26	Eumelan	June 8	June 10	June ?
8..	13	Herbert	June 9	June 12	June 14
8..	15	Hercules	June 9	June 11	June 15
11..	25	Jefferson	June 13	June 15	June 17
7..	3	Jefferson	June 12	June 15	June ?
11..	25	Lindley	June 9	June 10	June 15
8..	10	Merrimack	June 10	June 13	June 15
8..	11	Nectar	June 10	June 14	June 20
11..	20	Nectar	June 10	June 14	June 16
11..	24	Niagara	June 7	June 9	June 13
11..	26	Rochester	June 7	June 9	June 15
11..	26	Salem	June 9	June 10	June ?
11..	7	Station 125	June 10	June 12	June 21
11..	8	Station 146	June 9	June 12	June 21
11..	9	Station 156	June 10	June 12	June 20
11..	25	Vergennes	June 7	June 10	June 14
8..	1	Worden	June 9	June 12	June 16
11..	24	Worden	June 7	June 9	June 14
8..	17	Wyoming	June 10	June 13	June 15

DETAILED STATEMENT OF THE RESULTS.

Notes on the results were made at two different periods. First, soon after the vines had gone out of bloom a record was made of

the clusters which failed to set fruit. It is best to make such records early in the season because late in the season it may be impossible to decide whether the absence of a cluster means that it failed to set fruit or that the cluster was accidentally broken off. After the fruit ripened each cluster was rated on the scale of 100 according to the percentage of a full cluster of fruit which was found, as has already been stated under "Plan of Work." The detailed records are here given for each variety together with the records which the same variety has made in previous years when tested as to its self-fertility. Unless otherwise stated the tests here reported were made in 1899.

The results are summarized and presented graphically on the pages following the discussion of the separate varieties.

AMINIA.

Aminia self-pollinated.— In 1892, 2 clusters of Aminia which were kept covered during blooming season gave no fruit; in 1898, 9 clusters which were likewise tested gave no fruit. In 1899, 6 clusters of Aminia at Highlands were hand-pollinated[2] with Aminia pollen brought from the Station, but no fruit set; 10 clusters which were kept covered during the blooming season were rated 0, 0, 0, 0, 0, 0, 0, 0, 0, 12 respectively. Average rating 1.2. So far as tested Aminia is practically self-sterile.

Aminia pollinated with Brighton.—Six clusters tested at Highlands were rated respectively 0, 0, 0, 0, 0, 10. Average rating 1.7.

Aminia pollinated with Wyoming.— Five clusters tested at Highlands were rated respectively 0, 0, 0, 0, 20. Average rating 4.

Aminia pollinated with Niagara.— One cluster tested at Highlands rated 80.

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[2] By "hand pollinating," is here meant brushing the clusters with the open flowers from another vine of the same kind, and then inclosing the pollinated cluster together with the cluster which furnished the pollen in a bag according to the method followed in the 1899 experiments in cross-pollinating, as described on a preceding page.

Aminia pollinated with Worden.— Two clusters tested at Highlands were rated respectively 88, 88. Average rating 88.

Aminia pollinated with Catawba.— Four clusters tested at Highlands were rated respectively 88, 88, 90, 90. Average rating 89.

Aminia as a fertilizer.— The records of the tests of Aminia pollen upon Brighton and Wyoming are given under the discussion of these varieties. (See Index for pages.)

BARRY.

Barry self-pollinated.— In 1892, 2 clusters of Barry which were kept covered during the blooming season gave no fruit. Ten clusters in 1895 and 8 clusters in 1898 which were likewise covered gave no fruit. So far as tested Barry has proved completely self-sterile.

Barry pollinated with Black Eagle.— Five clusters tested at the Station gave no fruit.

Barry pollinated with Hercules.— Five clusters tested at the Station gave no fruit.

The vine on which these tests with the pollen of Black Eagle and Hercules were made stands in a mixed vineyard. The uncovered clusters were well formed and the yield abundant.

BLACK EAGLE.

Black Eagle self-pollinated.— In 1892, 2 clusters of Black Eagle which were kept covered during the blooming season gave no fruit; 10 clusters likewise covered in 1895 gave no fruit. So far as tested Black Eagle is completely self-sterile. Standing in a mixed vineyard it has produced some well-formed clusters, but often the clusters are imperfectly filled.

Black Eagle pollinated with Brighton.— Four clusters tested at the Station gave no fruit.

Black Eagle pollinated with Worden.— One cluster tested gave no fruit.

Black Eagle as a fertilizer.— The records of the test of Black Eagle pollen upon Barry are given under the latter variety.

BRIGHTON.

Brighton self-pollinated.— In 1892, 9 clusters of Brighton which were kept covered during the blooming season gave no fruit; 5 clusters at the Station in 1895, 27 clusters at the Station in 1897 and 9 clusters at Penn Yan in 1899 likewise covered gave no fruit. In another vineyard, of 25 clusters covered in 1897 24 clusters were rated 0, 1 cluster rated 10. Average rating 0.4. In still another locality 5 clusters likewise tested in 1897 were rated respectively 0, 0, 10, 10, 10. Average rating 6. At Highlands in 1899, of 28 clusters which were tested, 26 clusters were rated 0, 1 cluster rated 1 and 2 clusters rated 4. Average rating 0.2. At Penn Yan 5 clusters were hand-pollinated[3] with Brighton pollen from another vine. Four of these rated 0 and 1 rated 4. Average rating 0.8. At Highlands 10 clusters were likewise pollinated with Brighton pollen from a Station vineyard. Six of these were rated 0, 3 rated 2 and 1 rated 15. Average rating 2.1. From these tests it appears that Brighton clusters when self-pollinated rarely set any fruit and the variety may be called practically self-sterile.

Brighton pollinated with Creveling.— Seven clusters tested at Highlands gave no fruit.

Brighton pollinated with Salem.— Four clusters tested at Penn Yan gave no fruit.

Brighton pollinated with Aminia.— Six of the seven clusters tested at Highlands were rated 0 and 1 rated 2. Average rating 0.3.

Brighton pollinated with Wyoming.— Six clusters were tested at Highlands; 5 clusters gave a rating of 0 and 1 gave a rating 2. Average rating 0.3.

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[3] See foot note 2, page 340.

Brighton pollinated with Lindley.— Four of the five clusters tested at Penn Yan were rated 0 and 1 rated 10. Average rating 2.

Brighton pollinated with Eldorado.— Four clusters tested at Penn Yan were rated respectively 0, 0, 6, 15. Average rating 5.2.

Brighton pollinated with Station 146[4] — Four clusters tested at Penn Yan were rated respectively 0, 0, 25, 60. Average rating 21.3.

Brighton pollinated with Station 156[4].— Four clusters tested at Penn Yan were rated respectively 4, 85, 88, 100. Average rating 69.3.

Brighton pollinated with Merrimack.— Four clusters tested at Penn Yan were rated respectively 0, 0, 0, 100. Average rating 25.

Since Merrimack is self-sterile, and because in the other tests it uniformly failed to fertilize self-sterile sorts, and because in these tests on Brighton it failed to fertilize three of the four clusters upon which it was tried, while the fourth cluster was rated 100, it is desirable that these tests be repeated before definite conclusions are drawn. Similar results, however, were obtained by pollinating Brighton with Herbert, and Herbert like Merrimack is self-sterile.

Brighton pollinated with Herbert.— Four clusters tested at Penn Yan were rated respectively 0, 12, 25, 75. Average rating 28. Compare this record with results given in the preceding paragraph.

Brighton pollinated with Nectar.— Five clusters tested at Penn Yan were rated respectively 0, 20, 50, 50, 75. Average rating 40.

Brighton pollinated with Vergennes.— Seven clusters tested at Highlands were rated respectively 2, 40, 60, 75, 100, 100. Average rating 53.9. One of the perfect clusters was an unusually

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[4] Station 146 and Station 156 are male hybrids of *Vitis labrusca* L., by *Vitis bicolor*, Le Co te. They were produced by crossing a wild male *bicolor* upon the Winchell.

large, double, perfectly filled cluster. The other perfect cluster was also a very fine one.

Brighton pollinated with Jefferson.— Five clusters tested at Penn Yan were rated respectively 0, 25, 40, 60, 95, 100. Average rating 64.

Brighton pollinated with Rochester.— Five clusters tested at Penn Yan were rated respectively 0, 85, 85, 90, 100. Average rating 72.

Brighton pollinated with Catawba.— Eight clusters tested at Highlands were rated respectively 55, 55, 60, 75, 80, 85, 90, 95. Average rating 74.4.

At Penn Yan five clusters of Brighton pollinated with Catawba were rated 10, 90, 100, 100, 100, respectively. Average rating 80. As stated on a previous page, many of the blossoms of these two varieties had not yet opened when the hand pollinating was done.

Brighton pollinated with Worden.— Eight clusters tested at Highlands were rated respectively 50, 75, 78, 80, 80, 83, 85, 85. Average rating 77. Four clusters tested at Penn Yan were rated respectively 4, 100, 100, 100. Average rating 76.

Brighton pollinated with Niagara.— Nine clusters tested at Highlands were rated respectively 75, 80, 88, 88, 88, 88, 88, 88, 88. Average rating 85.7.

Five clusters tested at Penn Yan were rated respectively 2, 10, 60, 88, 100. Average rating 52.5.

Brighton pollinated with Station 125[5]. Five clusters tested at Penn Yan were rated respectively 50, 100, 100, 100, 100. Average rating 90.

Brighton as a fertilizer.— Tests of Brighton as a fertilizer for self-sterile varieties were made with several self-sterile kinds of grapes. The results are given in detail under Aminia, Black Eagle, Eldorado, Herbert, Hercules, Lindley, Merrimack, Salem and Wyoming. (See Index for pages.)

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[5] Station 125 is a white seedling of Winchell fertilized by Diamond. It is perfectly self-fertile.

CATAWBA.

Catawba self-pollinated.— In 1894, 12 clusters of Catawba which were kept covered during the blooming season, were, with one exception, nearly perfectly filled, averaging about 90. At Penn Yan 16 clusters which were likewise tested in 1897 were rated 50, 70, 70, 70, 70, 80, 80, 90, 90, 90, 90, 90, 90, 90, 90, 100, respectively. Average rating 81.9. At Branchport in 1897, of 22 clusters which were likewise tested, 1 was rated 70, 9 rated 80 and 12 rated 90, respectively, averaging 85. In 1899, of 42 clusters likewise tested at Highlands, 4 rated 80, 1 rated 83, 3 rated 85, 11 rated 88, 11 rated 90, 2 rated 93, 4 rated 95, 1 rated 97, 2 rated 98 and 3 rated 100, respectively, averaging 89.9. Twenty-four clusters were tested at Penn Yan, of which 5 were rated 0, 75, 75, 78 and 80, respectively, 5 rated 88, 6 rated 90, 7 rated 95 and 1 rated 98, averaging 85.5. Seventeen clusters which were tested at the Station were rated 50, 75, 80, 83, 85, 88, 88, 90, 90, 90, 90, 90, 90, 90, 95, 95, 95, respectively, averaging 86.1.

Taking all these tests into consideration it appears that Catawba is strongly self-fertile and when self-pollinated generally forms well-filled clusters of fruit.

Catawba as a fertilizer.— Several tests were made with Catawba as a fertilizer for self-sterile varieties. The results are given in detail under Aminia, Brighton, Eldorado, Herbert, Lindley, Merrimack, Salem and Wyoming.

COLUMBIAN IMPERIAL.

Columbian Imperial self-pollinated.— In 1897, 8 clusters of Columbian Imperial which were kept covered during the blooming season, were rated 90, 90, 90, 100, 100, 100, 100, 100, respectively, averaging 96.3. It appears to be fully self-fertile.

Columbian Imperial as a fertilizer.— It was used as a fertilizer for Hercules. See page 378.

CREVELING.

Creveling self-pollinated.— In 1894, 5 clusters of Creveling were kept covered during the blooming season, none of which

gave any fruit. In 1895, 5 clusters, and 1897, 5 clusters, which were likewise tested, gave no fruit. From these tests it appears that Creveling is absolutely self-sterile.

Creveling as a fertilizer.— It was tried as a fertilizer for Brighton, but no fruit was produced. See page 372.

It is interesting to note in this connection that, although Creveling failed to fertilize Brighton, the parentage of Mills is given as a Muscat Hamburg fertilized with Creveling.

EATON.

Eaton self-pollinated.— In 1894, 10 clusters which were kept covered during the blooming season gave no fruit. From the fact that the vine which was used for this test proved to be neither in a vigorous nor in a productive condition these results were not looked upon as conclusive. In 1899, 6 clusters on another vine, which were likewise covered, were rated 75, 80, 90, 95, 100, 100, respectively, averaging 90.

Eaton as a fertilizer.— It was tried as a fertilizer for Hercules. See page 378.

ELDORADO.

Eldorado self-pollinated.— In 1894, 5 clusters of Eldorado which were kept covered during the blooming season, gave no fruit. In 1895, 10 clusters; in 1897, 23 clusters; and in 1899, 4 clusters likewise tested gave no fruit.

The following tests of Eldorado were made at Penn Yan in 1899:

Eldorado pollinated with Brighton.— Five clusters tested gave no fruit.

Eldorado pollinated with Herbert.— Five clusters tested gave no fruit.

Eldorado pollinated with Lindley.— Five clusters tested gave no fruit.

Eldorado pollinated with Salem.— Five clusters which were tested were rated respectively 0, 0, 0, 0, 2. Average rating 0.4.

Eldorado pollinated with Catawba.— Four clusters which were tested were rated, respectively, 0, 0, 0, 2. Average rating 0.5.

Catawba is a self-fertile variety. In these tests self-fertile sorts have generally been good fertilizers for the self-sterile kinds. No explanation is offered for the exceptional results which followed the pollination of Eldorado with Catawba. There seems to be no good ground for the opinion that the Eldorado pistils were defective, for the clusters on the tested vines which were open to cross-pollination were unusually well formed, and some excellent clusters were also obtained by fertilizing Eldorado with Worden and Niagara. Catawba fertilized other self-sterile sorts very successfully in these tests, with the exception of Salem.[6]

Eldorado pollinated with Worden.— Five clusters which were tested were rated respectively 20, 60, 75, 75, 95. Average rating 65.

Eldorado pollinated with Niagara.— Five clusters which were tested were rated respectively 50, 60, 75, 95, 100. Average rating 76.

Eldorado as a fertilizer.— Eldorado was tried as a fertilizer on two self-sterile sorts, Brighton and Herbert, under which varieties will be found the details of the tests.

EUMELAN.

Eumelan self-pollinated.— In 1892, 10 clusters of Eumelan which were kept covered during the blooming season, gave no fruit. In 1895, 9 clusters which were likewise tested gave no fruit. In 1893, 3 clusters which were likewise tested were rated respectively 0, 0, 4. Average rating 1.3. In 1899, 1 cluster which was likewise tested was rated 20. In view of all these tests it appears that with rare exceptions Eumelan fails to set any fruit when self-pollinated, and it may be classed as practically self-sterile.

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[6] Salem fertilized by Catawba, rated 4, but only a single cluster was tested so that no conclusions can be drawn till the results are verified by further investigation.

Eumelan pollinated with Black Eagle.— Two clusters tested at the Station gave no fruit. The work was done on the fifth day after Eumelan came into full bloom, and the treated clusters may have been too far advanced in bloom to give favorable results from cross-pollination. These tests should be repeated.

HERBERT.

Herbert self-pollinated.— In 1892, 2 clusters of Herbert which were kept covered during the blooming season gave no fruit.

In 1895, 5 clusters and in 1899, 9 clusters, which were likewise tested, gave no fruit. So far as tested, Herbert has been found self-sterile.

The following tests with Herbert in 1899 were made at Penn Yan:

Herbert pollinated with Brighton.— One cluster which was tested gave no fruit.

Herbert pollinated with Eldorado.— Four clusters which were tested gave no fruit.

Herbert pollinated with Lindley.— Five clusters which were tested gave no fruit.

Herbert pollinated with Merrimack.— Five clusters which were tested gave no fruit.

Herbert pollinated with Salem.— Four clusters which were tested gave no fruit.

Herbert pollinated with Worden.— Five clusters which were tested were rated respectively 95, 95, 95, 100, 100. Average rating 97.

Herbert pollinated with Niagara.— Four clusters which were tested were rated respectively 95, 100, 100, 100. Average rating 98.8.

Herbert pollinated with Catawba.— Two clusters which were tested were rated respectively 100, 100. Average rating 100.

Herbert as a fertilizer.— Herbert was tried as a fertilizer on three self-sterile sorts, Brighton, Eldorado and Salem. See pages 372, 375, 381, respectively.

HERCULES.

Hercules self-pollinated.— In 1893, 4 clusters of Hercules which were kept covered during the blooming season, bore no fruit. In 1895, 10 clusters tested in like manner gave no fruit. In 1899, 1 cluster covered in like manner produced a well-formed cluster made up entirely of small, seedless fruits.

Hercules pollinated with Brighton.— Two clusters were tested in a Station vineyard, one of which set no fruit, the other was filled with seedless fruits like the cluster described in the last paragraph.

Hercules pollinated with Columbian Imperial.— Five clusters in a Station vineyard were tested. They were rated 20, 30, 30, 40, 50, respectively, averaging 36.

Hercules pollinated with Eaton.— Five clusters in a Station vineyard were tested. They were rated 0, 0, 30, 70, 70, respectively, averaging 36.

Hercules as a fertilizer.— Hercules was tried as a fertilizer for Barry. See page 370.

JEFFERSON.

Jefferson self-pollinated.— In 1893, 3 clusters of Jefferson were kept covered during the blooming season. They rated on the average about 95. In 1894, 4 clusters likewise tested were rated 0, 100, 100, 100, respectively, averaging 75. In 1899, 7 clusters were covered on a vine which afterwards appeared to be not in a satisfactory condition for testing. These clusters were rated 20, 20, 25, 45, 45, 60, 60, respectively, averaging 39.3. From these tests it appears that Jefferson is strongly self-fertile when the vine is in good condition.

Jefferson as a fertilizer.— Pollen from the vine which in 1899 made the record which is given in the preceding paragraph, was tried on Brighton. See page 373.

LINDLEY.

Lindley self-pollinated.— In 1894, 10 clusters of Lindley, which were kept covered during the blooming season, set no fruit. In

1895, 9 clusters and in 1897, 25 clusters, which were likewise covered, set no fruit. In another locality, of 25 clusters which were likewise tested in 1897, 24 were rated 0, and 1 rated 40. Average rating 1.6. In view of these tests, Lindley may be called practically self-sterile.

The following tests with Lindley in 1899 were made at Penn Yan:

Lindley pollinated with Merrimack.— Three clusters which were tested produced no fruit.

Lindley pollinated with Salem.— Five clusters which were tested gave no fruit.

Lindley pollinated with Brighton.— Three clusters which were tested were rated 0, 0, 12, respectively, average rating 4.

Lindley pollinated with Catawba.— Five clusters which were tested were rated 40, 40, 55, 85, 95, respectively. Average rating 63.

Lindley pollinated with Worden.— Five clusters which were tested were rated 0, 50, 100, 100, 100, respectively. Average rating 70.

Lindley pollinated with Niagara.— Five clusters which were tested were rated 40, 70, 90, 90, 95, respectively, averaging 77.

Lindley as a fertilizer.— Several tests were made with Lindley as a fertilizer for self-sterile sorts. The results are given in detail for Brighton, Eldorado, Herbert, Merrimack and Salem under the several discussions of these varieties.

MERRIMACK.

Merrimack self-pollinated.— In 1892, 2 clusters which were tested, gave no fruit. In 1895, 10 clusters; in 1897, 23 clusters, and in 1899, 3 clusters, which were likewise tested, gave no fruit. From these tests it appears that Merrimack is completely self-sterile.

The following tests with Merrimack were made at Penn Yan:

Merrimack pollinated with Salem.— Five clusters which were tested, were rated 0, 0, 0, 0, 4, respectively. Average rating 0.8.

Merrimack pollinated with Brighton.— Four clusters which were tested, were rated 0, 0, 0, 35, respectively. Average rating 8.8.

Merrimack pollinated with Lindley.— Four clusters which were tested, were rated 0, 15, 15, 98, respectively. Average rating 32.

Merrimack pollinated with Catawba.— Three clusters which were tested, were rated 90, 90, 95, respectively. Average rating 91.7.

Merrimack pollinated with Niagara.— Four clusters which were tested, were rated 95, 95, 95, 100, respectively. Average rating 96.3.

Merrimack pollinated with Worden.— Four clusters which were tested, were rated 90, 98, 100, 100, respectively. Average rating 97.

Merrimack as a fertilizer.— Several tests were made with Merrimack as a fertilizer for self-sterile sorts. The results are given in detail under the discussions of Brighton, Herbert, Lindley and Salem.

NECTAR.

Nectar self-pollinated.— In 1894, 6 of the 9 clusters which were kept covered during the blooming season were rated 0, 2 rated 2 and 1 rated 4, averaging 0.9 per cluster. In 1899, 2 clusters which were likewise tested, rated 80, 100, averaging 90. Further testing is needed to determine whether or not Nectar is strongly self-fertile.

Nectar as a fertilizer.— It was tried as a fertilizer for Brighton. See page 372.

NIAGARA.

Niagara self-pollinated.— In 1892, 10 clusters of Niagara, which were kept covered during the blooming season, gave perfect clusters, which rated from 97 to 100. In 1897, of 23 clusters at Penn Yan, which were likewise tested, 1 was rated 40, 5 rated 60, 3 rated 70, 9 rated 80, 3 rated 90, and 2 rated 100, respectively, averaging 75.7. Twelve clusters tested at Branchport were

rated 30, 40, 50, 60, 60, 60, 70, 80, 80, 80, 80, 100, averaging 65.8.

In 1899, 16 Niagara clusters at Highlands were likewise tested. They were rated 85, 90, 90, 90, 93, 93, 93, 95, 95, 98, 100, 100, 100, 100, 100, 100, respectively, averaging 95.1. At Penn Yan, 20 clusters which were likewise tested, were rated 65, 80, 88, 90, 90, 90, 95, 95, 95, 95, 95, 98, 98, 98, 98, 98, 98, 100, 100, 100, respectively, averaging 93.3.

Taking all these tests into consideration it appears that generally Niagara is strongly self-fertile.

Niagara as a fertilizer.— Several tests were made with Niagara as a fertilizer for self-sterile sorts. The results in detail are given under Aminia, Brighton, Eldorado, Herbert, Lindley, Merrimack and Salem.

ROCHESTER.

Rochester self-pollinated.— In 1894, 10 clusters of Rochester, which were kept covered during the blooming season, all gave very compact and perfect clusters of fruit. One cluster, which was likewise tested in 1899, gave a perfect cluster of fruit, rated at 100. From these tests it appears that Rochester is perfectly self-fertile.

Rochester as a fertilizer.— It was tried as a fertilizer for Brighton. See page 373.

SALEM.

Salem self-pollinated.— In 1892, 10 clusters of Salem, which were kept covered during the blooming season, set no fruit. In 1897, 23 clusters in one locality, and 5 clusters in another, which were likewise tested, gave no fruit. From these tests it appears that Salem is completely self-sterile.

The following tests with Salem were made in 1899 at Penn Yan:

Salem pollinated with Brighton.— Three clusters which were tested produced no fruit.

Salem pollinated with Herbert.— Five clusters which were tested gave no fruit.

Salem pollinated with Merrimack.— Four clusters which were tested gave no fruit.

Salem pollinated with Lindley.— Four clusters which were tested were rated 0, 0, 0, 0, 2, respectively. Average rating 0.4.

Salem pollinated with Catawba.— One cluster which was tested was rated 4. The test should be repeated and a large number of clusters tried before drawing conclusions on the value of Catawba as a fertilizer for Salem. Catawba gave similar results when used with Eldorado. See page 376.

Salem pollinated with Worden.— Five clusters which were tested were rated 60, 90, 95, 100, 100. Average rating 89.

Salem pollinated with Niagara.— Five clusters which were tested were rated 95, 95, 100, 100, 100. Average rating 98.

Salem as a fertilizer.— Several tests were made with Salem as a fertilizer for self-sterile sorts. The results are given in detail under Brighton, Eldorado, Herbert, Lindley and Merrimack.

STATION 125.

Station 125 *self-pollinated.*— In 1899, 10 clusters of *Station* 125 were kept covered during the blooming season. They all gave perfect clusters, the average rating being 100. *Station* 125 is a white seedling of Winchell, fertilized with Diamond.

Station 125 *as a fertilizer.*— It was tried as a fertilizer for Brighton. See page 373.

STATION 146.

Station 146 is a male vine, a seedling of Winchell fertilized by a wild vine of *Vitis bicolor* Le Conte. It is, therefore, a hybrid of *V. labrusca by V. bicolor*. It was tried as a fertilizer for Brighton. See page 372.

STATION 156.

Station 156 is also a male vine having the same parentage as *Station* 146 which is given in the preceding paragraph. It was used as a fertilizer for Brighton. See page 372.

VERGENNES.

Vergennes self-pollinated.— In 1894, 10 clusters which were kept covered during the blooming season gave clusters of fruit which on the average were about as well filled and as compact as ordinary Concords. In 1897, 22 clusters which were tested at Penn Yan were rated 0, 0, 20, 30, 30, 30, 40, 40, 40, 40, 50, 50, 50, 50, 50, 60, 60, 60, 60, 60, 70, 90, respectively, averaging 44.5. At Branchport 5 clusters which were likewise tested, were rated 0, 0, 40, 40, 40. They averaged 24.

In 1899, 8 clusters were tested in a Station vineyard. They rated 70, 70, 70, 75, 80, 80, 85, 90, respectively, averaging 77.5. On another vine which has stood in uncultivated ground and has repeatedly been overloaded with fruit, 9 clusters were also tested. These rated 0, 0, 0, 2, 65, 75, 85, 88, 95, respectively, and averaged 45.6.

From these tests it appears that Vergennes is not always strongly self-fertile.

Vergennes as a fertilizer.— It was tried as a fertilizer for Brighton. See page 372.

WORDEN.

Worden self-pollinated.— In 1894, 10 clusters of Worden which were kept covered during the blooming season gave clusters which varied from perfect or nearly so to somewhat loose, averaging somewhat loose. In 1895, 9 clusters which were tested were perfectly filled with fruit. In 1897, 23 clusters in a Station vineyard were tested; 2 clusters were rated 80, 4 rated 90 and 17 rated 100, respectively, averaging 96.5. At Penn Yan, of 20 clusters which were tested, 2 were rated 80, 7 rated 90 and 11 rated 100, respectively, averaging 94.5. At Branchport 5 clusters which were tested were rated 80, 80, 80, 90, 90, respectively, averaging 84.

In 1899, 6 clusters in a Station vineyard which were likewise tested were rated 90, 90, 95, 100, 100, 100, respectively, and averaged 95.8. At Highlands, of 24 clusters which were tested, 3 were rated 75, 83 and 85, respectively, and 3 were rated 88, 3

rated 90, 5 rated 95, 2 rated 98 and 8 rated 100, respectively, averaging 93.7. At Penn Yan 20 clusters were likewise tested. Seven of these were rated 75, 90, 90, 95, 95, 95 and 98, respectively, and 13 were rated 100. The average was 96.9.

From these tests it appears that Worden, generally, is strongly self-fertile.

Worden as a fertilizer.— Several tests were made with Worden as a fertilizer for self-sterile sorts. The results in detail are given under Aminia, Black Eagle, Brighton, Eldorado, Herbert, Lindley, Merrimack and Salem.

WYOMING.

Wyoming self-pollinated.— In 1896, 10 clusters of Wyoming which were kept covered during the blooming season gave no fruit. In 1899, 4 clusters which were likewise tested at the Station were rated 0, 0, 0, 4, respectively. Average rating 1. At Highlands 13 clusters were kept covered during the blooming season. Twelve of them set no fruit. The remaining cluster was well filled. It was on a shoot which had been bent in tying it to the trellis so that the flow of sap was somewhat checked. Before it had been rated it was taken by other parties. It would probably rank as high as 90. On the same vines the uncovered clusters which were exposed during the blooming season to cross-pollination were often well-filled, but sometimes loose and quite imperfectly filled clusters were found.

At Highlands 6 clusters were hand-pollinated[7] with Wyoming pollen taken from a vine in a Station vineyard. They rated 0, 0, 5, 10, 25, 90, respectively. Average rating 21.6.

In view of all of these tests, it appears, that although Wyoming may sometimes produce a small amount of fruit when self-pollinated, for all practical purposes it may be ranked as self-sterile.

The following tests were made in 1899 with Wyoming at Highlands:

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[7] See foot note page 369.

Wyoming pollinated with Aminia.— Four clusters which were tested, were rated 0, 0, 0, 8, respectively. Average rating 2.

Wyoming pollinated with Brighton.— Six clusters which were tested, were rated 0, 0, 0, 0, 22, 50, respectively. Average rating 12.

Wyoming pollinated with Catawba.— One cluster which was tested formed a perfect cluster of fruit. It was rated 100.

Wyoming as a fertilizer.— It was tried as a fertilizer on two self-sterile sorts, Aminia, page 369, and Brighton, page 371.

SUMMARY OF RESULTS.

In the following summary of the results of the investigation the data which have been given on preceding pages are arranged in Table II with reference to the ability of each variety to fertilize the self-sterile sorts upon which it was tried as compared with its ability to fertilize itself, and in Table III with reference to the varying degrees of fruitfulness which the self-sterile varieties exhibit when they are supplied with pollen from various varieties, some of which are more or less self-sterile and others self-fertile.

Explanation of tables.— The x between two names indicates that the variety following the x was used in pollinating the variety whose name appears before the x. Thus, Brighton x Aminia indicates that the Brighton clusters were pollinated with Aminia pollen in the manner described on page 364. The rating is on the scale of 100 points as previously explained, a perfectly formed and perfectly filled cluster ranking 100. The average rating is shown graphically and the number of tested clusters upon which the average is based is also stated. The highest rating which any single cluster in the test received is also given.

" Self-pollinated " indicates that the tested clusters were simply kept covered in paper bags during the blooming season. Sometimes the self-pollination was performed by hand, pollen from another vine of the same kind being applied in the manner described in the foot-note, page 369. Such tests are marked " hand pollinated " in the table.

TABLE II.—COMPARATIVE FRUITAGE WITH DIFFERENT VARIETIES OF GRAPES TRIED AS FERTILIZÈRS FOR SELF-STERILE SORTS.

VARIETIES TESTED.	Number of clusters under test.	Highest rating.	Average rating.	Graphic representation of average rating.
Aminia as a fertilizer:				
Self-pollinated	2	0.	0.	
Self-pollinated	9	0.	0.	
Self-pollinated	6	0.	0.	
Self-pollinated	10	12.	1.2	
Brighton x Aminia	7	2.	0.8	
Wyoming x Aminia	4	8.	2.	
Black Eagle as a fertilizer:				
Self-pollinated	2	0.	0.	
Self-pollinated	10	0.	0.	
Barry x Black Eagle	5	0.	0.	
Eumelan x Black Eagle	2	0.	0.	
Brighton as a fertilizer:				
Self-pollinated	9	0.	0.	
Self-pollinated	5	0.	0.	
Self-pollinated	27	0.	0.	
Self-pollinated	9	0.	0.	
Self-pollinated	28	4.	0.2	
Self-pollinated	25	10.	0.4	
Self-pollinated*	5	4.	0.8	
Self-pollinated*	10	15.	2.1	
Self-pollinated	5	[illegible]0.	6.0	
Black Eagle x Brighton	4	0.	0.0	
Eldorado x Brighton	5	0.	0.0	
Herbert x Brighton	1	0.	0.0	
Salem x Brighton	8	0.	0.0	
Aminia x Brighton	6	10.	1.7	
Lindley x Brighton	8	12.	4.0	
Merrimack x Brighton	4	35.	8.5	
Wyoming x Brighton	6	50.	12.0	
Hercules x Brighton†	2	?	?	
Catawba as a fertilizer:				
Self-pollinated	12	‡	‡	
Self-pollinated	16	100.	81.9	
Self-pollinated	22	90.	85.0	
Self-pollinated	87	100.	89.9	
Self-pollinated	24	98.	85.5	
Self-pollinated	17	95.	86.1	
Eldorado x Catawba	4	2.	0.5	
Salem x Catawba	1	4.	4.0	
Lindley x Catawba	5	95.	63.0	

* Hand-pollinated.
† See page 378.
‡ The clusters were perfect, or nearly so, but were not rated on the scale of 100 points.

TABLE II — *Continued.*

VARIETIES TESTED.	Number of clusters under test	Highest rating.	Average rating.	Graphic representation of average rating.
Brighton x Catawba....	8	95.	74.4	
Brighton x Catawba...	5	100.	80.0	
Aminia x Catawba......	4	90.	89.0	
Merrimack x Catawba..	3	95.	91.7	
Herbert x Catawba.....	2	100.	100.	
Wyoming x Catawba...	1	100.	100.	
Columbian Imperial as a fertilizer:				
Self-pollinated..........	8	100.	96.8	
Hercules x Colum. Imp.	5	50.	36.0	
Creveling as a fertilizer:				
Self-pollinated..........	5	0.	0.0	
Self-pollinated....... .	5	0.	0.0	
Self-pollinated	5	0.	0.0	
Brighton x Creveling...	7	0.	0.0	
Eaton as a fertilizer:				
Self-pollinated..........	10	0.	0.0	
Self-pollinated	6	100.	90.0	
Hercules x Eaton.......	5	70.	36.0	
Eldorado as a fertilizer:				
Self-pollinated..........	5	0.	0.0	
Self-pollinated..........	10	0.	0.0	
Self-pollinated	23	0.	0.0	
Self-pollinated....	4	0.	0.0	
Herbert x Eldorado....	4	0.	0.0	
Brighton x Eldorado ...	4	15.	5.2	
Eumelan as a fertilizer:				
Self-pollinated..........	10	0.	0.0	
Self-pollinated..........	9	0.	0.0	
Self-pollinated..........	3	4.	1.8	
Self-pollinated	1	20.	20.	
Herbert as a fertilizer:				
Self-pollinated.........	2	0.	0.0	
Self-pollinated	5	0.	0.0	
Self pollinated	9	0.	0.0	
Salem x Herbert........	5	0.	0.0	
Eldorado x Herbert.....	5	0.	0.0	
Brighton x Herbert....	4	75.	28.0	
Hercules as a fertilizer:				
Self-pollinated..........	4	0.	0.0	
Self-pollinated..........	10	0.	0.0	
Self-pollinated	1	*	*	
Barry x Hercules.......	5	0.	0.0	

* One good cluster well filled, but all fruits seedless.

TABLE II — *Continued.*

VARIETIES TESTED.	Number of clusters under test.	Highest rating.	Average rating.	Graphic representation of average rating.
Jefferson as a fertilizer:				
Self-pollinated...... ...	3	....	95.0	
Self-pollinated..........	4	100.	75.0	
Self-pollinated	7	60.	39.3	
Brighton x Jefferson....	5	100.	64.0	
Lindley as a fertilizer:				
Self-pollinated..........	10	0.	0.0	
Self-pollinated..........	9	0.	0.0	
Self-pollinated..........	25	0.	0.0	
Self-pollinated..........	25	40.	1.6	
Eldorado x Lindley.....	5	0.	0.0	
Herbert x Lindley	5	0.	0.0	
Salem x Lindley........	5	2.	0.4	
Brighton x Lindley	5	10.	2.0	
Merrimack x Lindley ...	4	98.	33.0	
Merrimack as a fertilizer:				
Self-pollinated...... ...	2	0.	0.0	
Self-pollinated..........	10	0.	0.0	
Self-pollinated..........	23	0.	0.0	
Self-pollinated.........	3	0.	0.0	
Salem x Merrimack. ...	4	0	0.0	
Lindley x Merrimack ...	3	0.	0.0	
Herbert x Merrimack ...	5	0.	0.0	
Brighton x Merrimack ..	4	100.	25.	
Nectar as a fertilizer:				
Self-pollinated..........	9	4.	....	
Self-pollinated..........	2	100.	0.9	
Brighton x Nectar	5	75.	90.0	
Niagara as a fertilizer:	...	....	40.0	
Self-pollinated....	10	100.	....	
Self-pollinated..........	23	100.	75.7	
Self-pollinated..........	12	100.	65.8	
Self-pollinated..........	16	100.	95.1	
Self-pollinated	20	100.	93.3	
Aminia x Niagara	1	80.	....	
Brighton x Niagara.....	5	100.	52 5	
Brighton x Niagara. ...	9	88.	85.7	
Eldorado x Niagara.....	5	100.	76.	
Lindley x Niagara	5	95.	77.0	
Merrimack x Niagara...	4	100.	96.3	
Salem x Niagara	5	100.	98.0	
Herbert x Niagara	4	100.	98.8	
Rochester as a fertilizer:				
Self-pollinated.........	10	100	100.	
Self-pollinated..........	1	100.	100.	
Brighton x Rochester...	5	100.	72.0	

TABLE II — *Continued.*

VARIETIES TESTED.	Number of clusters under test.	Highest rating.	Average rating.	Graphic representation of average rating.
Salem as a fertilizer:				
Self-pollinated	10	0.	0.0	
Self-pollinated..........	28	0.	0.0	
Self-pollinated.........	5	0.	0.0	
Lindley x Salem........	5	0.	0.0	
Herbert x Salem........	4	0.	0.0	
Brighton x Salem.......	4	0.	0.0	
Eldorado x Salem	5	2.	0.4	
Merrimack x Salem.....	5	4.	0.8	
Station 125 as a fertilizer:				
Self-pollinated..........	10	100.	100.0	
Brighton x Station 125..	5	100.	90.0	
Station 146 as a fertilizer:				
Brighton x Station 146..	4	60.	21.3	
Station 156 as a fertilizer:				
Brighton x Station 156..	4	100.	69.3	
Vergennes as a fertilizer:				
Self-pollinated	10	...	.....	
Self-pollinated...... ...	23	90.	44.5	
Self-pollinated..........	5	40.	24.0	
Self-pollinated...... ...	8	90.	77.5	
Self-pollinated	9	95.	45.6	
Brighton x Vergennes ..	7	100.	53.9	
Worden as a fertilizer:				
Self-pollinated..........	10	....	...	
Self-pollinated...... ...	9	100.	100.	
Self-pollinated..........	23	100.	96.5	
Self-pollinated..........	20	100.	94.5	
Self-pollinated...... ...	5	90.	84.0	
Self-pollinated..........	6	100.	95.8	
Self-pollinated	24	100.	93.7	
Self-pollinated	20	100.	96.9	
Black Eagle x Worden..	1	0.	0.0	
Eldorado x Worden	5	95.	65.0	
Lindley x Worden......	5	100.	70.0	
Brighton x Worden.....	4	100.	76.0	
Brighton x Worden.....	8	85.	77.0	
Aminia x Worden	2	88.	88.0	
Salem x Worden	5	100.	89.0	
Merrimack x Worden...	4	100.	97.0	
Herbert x Worden	5	100.	97.0	
Wyoming as a fertilizer:				
Self-pollinated...... ...	10	0.	0.0	
Self-pollinated..........	4	4.	1.0	
Self-pollinated...... ...	13	*	*	
Self-pollinated	6	90.	21.6	
Brighton x Wyoming...	6	2.	0.8	
Aminia x Wyoming ...	5	20.	4.0	

* But one cluster produced fruit, and that was gathered by grape pickers before it had been rated. Its rating was somewhere between 80 and 100, making the average between 6.1 and 7.7.

By consulting the above table it is seen that Brighton and Wyoming when pollinated with the self-sterile variety, Aminia, were practically sterile and gave no better results than are obtained when they are self-pollinated. Black Eagle succeeded no better than Aminia as a fertilizer. It was tried on the self-sterile varieties, Barry and Eumelan. Brighton was not more effective in fertilizing the self-sterile sorts, Black Eagle, Eldorado, Herbert, Salem, Aminia and Lindley than in fertilizing itself. Slightly better results were obtained when it was tried on Merrimack and Wyoming, but nothing that would encourage the use of Brighton as a fertilizer for self-sterile sorts. Creveling, which is self-sterile, failed to fertilize Brighton. Eldorado, which is self-sterile, gave no results which would encourage its use as a fertilizer for self-sterile sorts, and the same is true of the other self-sterile varieties, Hercules, Herbert, Lindley, Merrimack, Salem and Wyoming. Occasionally the use of a self-sterile variety as a pollinizer for other self-sterile kinds would result in the development of a good cluster as happened when Brighton was pollinated with Merrimack and again with Herbert, but even in such cases failure was the rule rather than the exception.

On the other hand, the use of self-fertile varieties as fertilizers for the self-sterile sorts generally was attended with good results, as may be seen by examining the records of such varieties as Catawba, Worden and Niagara and *Station* 125. When certain varieties which are not strongly self-fertile, were tried as fertilizers for self-sterile sorts they generally succeeded in about the same degree as they commonly do in fertilizing themselves. This point is illustrated in the record of the tests with Eaton, Nectar and Vergennes.

IS FAILURE IN SETTING FRUIT USUALLY DUE TO IMPERFECT PISTILS OR TO IMPERFECT OR IMPOTENT POLLEN?

It is instructive to study the results of these investigations with reference to their bearing upon the question whether the failure to set fruit which has been observed among the self-sterile and the imperfectly self-fertile varieties may generally be attributed to weakness of the pistils or to imperfect or impotent pollen. In

order to facilitate the study of the evidence on this point, which was obtained in the 1899 investigation, the data are arranged in Table III so as to show in each case the results which follow the use of various kinds of pollen upon the pistils of one variety.

TABLE III.— COMPARATIVE FRUITAGE OF GRAPES FROM USING THE POLLEN OF DIFFERENT VARIETIES UPON THE SAME SELF-STERILE VARIETIES.

Varieties Tested.	Number of Clusters under test.	Highest rating.	Average rating.
Aminia,[1] pollinated by:			
Brighton	6	10.	1.7
Wyoming	5	20.	4.0
Niagara	1	80.	80.0
Worden	2	88.	88.0
Catawba	4	90.	89.0
Barry,[2] pollinated by:			
Barry	2	0.	0.0
Barry	10	0.	0.0
Barry	8	0.	0.0
Black Eagle	0	0.	0.0
Hercules	5	0.	0.0
Black Eagle,[3] pollinated by:			
Brighton[4]	4	0.	0.0
Worden[4]	1	0.	0.0
Brighton,[5] pollinated by:			
Creveling	7	0.	0.0
Salem	4	0.	0.0
Aminia	7	2.	0.3
Wyoming	6	2.	0.3
Lindley	4	10.	2.0
Eldorado	5	15.	5.2
Station 146	4	60.	21.3
Merrimack	4	100.	25.0

Varieties tested.	Number of clusters under test.	Highest rating.	Average rating.
Brighton, pollinated by:			
Herbert	4	75.	28.0
Nectar	5	75.	40.0
Vergennes	7	100.	53.9
Jefferson	5	100.	64.0
Station 156	4	100.	69.3
Rochester	5	100.	72.0
Catawba	8	95.	74.4
Catawba	5	100.	80.0
Worden	4	100.	76.0
Worden	8	85.	77.0
Niagara	5	100.	52.5
Niagara	9	88.	85.7
Station 125	5	100.	90.0
Eldorado,[6] pollinated by:			
Brighton	5	0.	0.0
Herbert	5	0.	0.0
Lindley	5	0.	0.0
Salem	5	2.	0.4
Catawba	4	2.	0.5
Worden	5	95.	65.0
Niagara	5	100.	76.0
Eumelan,[7] pollinated by:			
Black Eagle	2	0.	0.0

[1] For results from self-pollinated Aminia, see page 386.

[2] The clusters of Barry which were open to cross-pollination in a mixed vineyard, were finely formed and well developed. This was true of the vine on which the tests with Black Eagle and Hercules were made.

[3] The summary of results with Black Eagle self-pollinated are given on page 386.

[4] On the vine which was used for these tests, the clusters of Black Eagle which were open to cross-pollination, were often well filled, yet many were quite imperfectly filled.

[5] The records of self-pollinated Brighton are summarized on page 386.

[6] The records of self-pollinated Eldorado are summarized on page 387.

[7] The records of self-pollinated Eumelan are summarized on page 387.

TABLE III — *Continued.*

Varieties tested.	Number of clusters under test.	Highest rating.	Average rating.	Varieties Tested.	Number of clusters under test.	Highest rating.	Average rating.
Herbert,[8] pollinated by:				Merrimack,[11] pollinated by:			
Brighton	1	0.	0.0	Salem	5	4.	0.8
Eldorado	4	0.	0.0	Brighton	4	35.	8.8
Lindley	5	0.	0.0	Lindley	4	98.	32.0
Merrimack	5	0.	0.0	Catawba	3	95.	91.7
Salem	4	0.	0.0	Niagara	4	100.	96.3
Worden	5	100.	97.0	Worden	4	100.	97.0
Niagara	4	100.	98.8	Salem,[12] pollinated by:			
Catawba	2	100.	100.0	Brighton	3	0.	0.0
Hercules,[9] pollinated by:				Herbert	5	0.	0.0
Brighton	2	*	*	Merrimack	4	0.	0.0
Columbian Imperial	5	50.	36.0	Lindley	5	2.	0.4
Eaton	5	75.	36.0	Catawba	1	4.	4.0
Lindley,[10] pollinated by:				Worden	5	100.	89.0
Merrimack	3	0.	0.0	Niagara	5	100.	98.0
Salem	5	0.	0.0	Wyoming,[13] pollinated by:			
Brighton	3	12.	4.0	Aminia	4	8.	2.0
Catawba	5	95.	63.0	Brighton	6	50.	12.0
Worden	5	100.	70.0	Catawba	1	100.	100.0
Niagara	5	95.	77.0				

An examination of the results which are summarized in Table III, shows that Aminia gave scarcely any fruit when fertilized with the imperfectly self-fertile sorts, Brighton and Wyoming, but fruited freely when fertilized with the self-fertile sorts, Niagara, Worden and Catawba. Barry gave no fruit when pollinated with either Black Eagle or Hercules, but clusters which were open to cross-pollination in a mixed vineyard, were well-filled with fruit.

[8] The records of self-pollinated Herbert are summarized on page 387.
[9] The records of self-pollinated Hercules are summarized on page 387.
[10] The records of self-pollinated Lindley are summarized on page 388.
[11] The records of self-pollinated Merrimack are summarized on page 388.
[12] The records of self-pollinated Salem are summarized on page 389.
[13] The records of self-pollinating Wyoming are summarized on page 389.

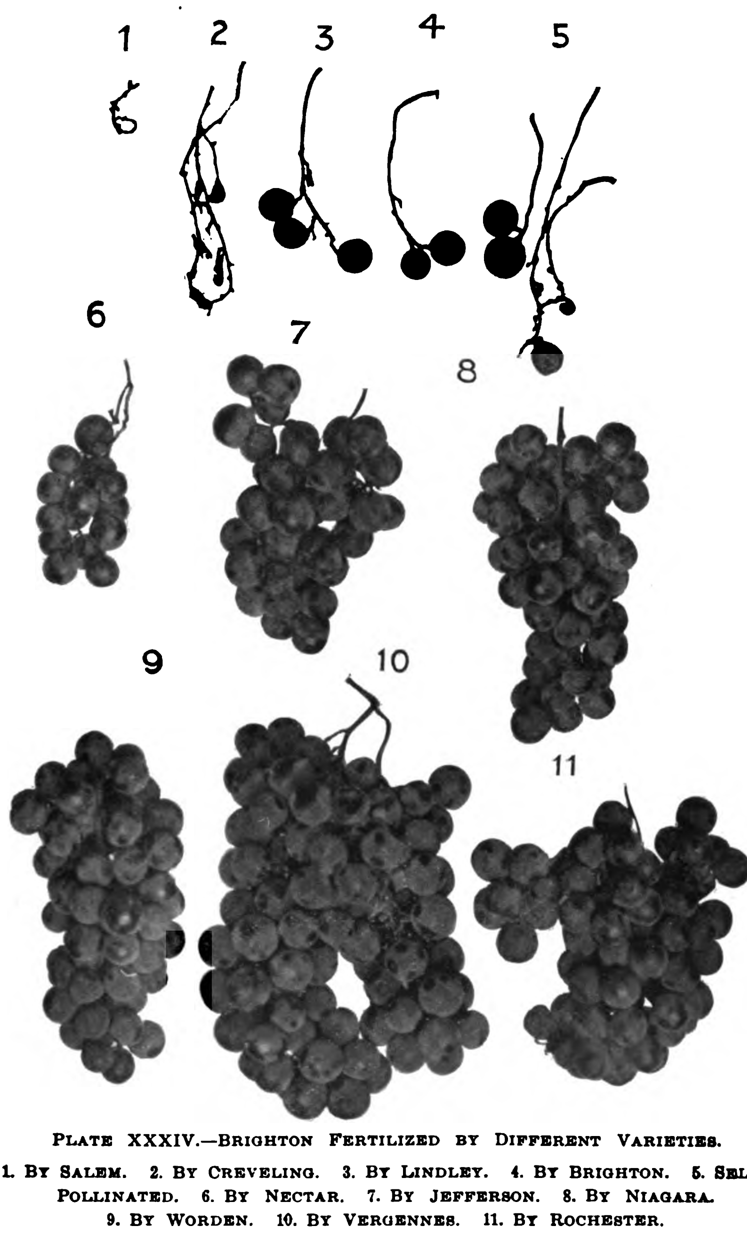

Plate XXXIV.—Brighton Fertilized by Different Varieties.

1. By Salem. 2. By Creveling. 3. By Lindley. 4. By Brighton. 5. Self-Pollinated. 6. By Nectar. 7. By Jefferson. 8. By Niagara. 9. By Worden. 10. By Vergennes. 11. By Rochester.

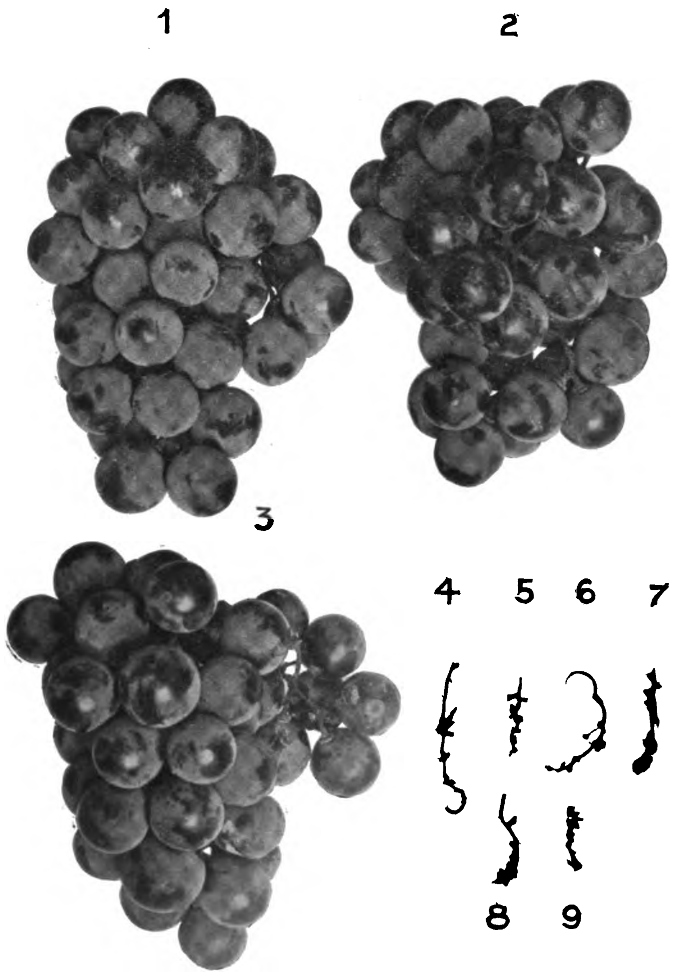

PLATE XXXV.—HERBERT FERTILIZED BY DIFFERENT VARIETIES.

1. BY NIAGARA. 2. BY WORDEN. 3. BY CATAWBA. 4. BY HERBERT. 5. BY BRIGHTON. 6. BY MERRIMACK. 7. BY ELDORADO. 8. BY LINDLEY. 9. BY SALEM.

Brighton gave little fruit or none when fertilized with the self-sterile or imperfectly self-fertile kinds, Creveling, Salem, Aminia, Wyoming, Lindley, Eldorado, Merrimack and Herbert. The use of varieties having a higher degree of self-fertility gave correspondingly better results as is shown in the records of Nectar, Vergennes and Jefferson, while the use of strongly self-fertile kinds for fertilizers gave more perfect clusters of fruit as is shown by the records of Rochester, Catawba, Worden, Niagara and *Station* 125.

Results corresponding to those given above were obtained with the different classes of varieties which were tried as fertilizers on Eldorado, Eumelan, Herbert, Hercules, Lindley, Merrimack, Salem and Wyoming. So far as these tests are concerned, they support the theory that the failure of self-sterile or imperfectly self-fertile grapes in setting fruit is not generally due to imperfect development of the pistils because when they are supplied with pollen from strongly self-fertile grapes they set fruit abundantly. It has been observed that blossom buds of certain varieties may in some cases drop off before the flowers open. It has also been observed that when the vines are not in good condition certain varieties which generally produce well-filled clusters of perfect fruit may have a large proportion of imperfect clusters. It appears, therefore, that failure in setting fruit may be due to various causes, prominent among which is the lack of proper pollination.

GRAPES CLASSIFIED ACCORDING TO THEIR BLOOMING SEASON.

In selecting varieties of grapes to be used as fertilizers for those kinds which are either self-sterile or imperfectly self-fertile, it seems desirable to chose not only strongly self-fertile kinds, but also kinds which come into blossom at the same time with those which they are expected to fertilize. The following lists have been arranged to show approximately the comparative season of blooming of the different varieties of grapes. The arrange-

ment is based upon the records for a series of years of the blooming season of the varieties in the Station vineyards. A large part of these records for the varieties named below were published in Bulletin 157. In making the following lists the records for 1899 are also taken under consideration, and accordingly they do not exactly correspond with those which were published in the popular edition of Bulletin 157. The lists are arranged to show in parallel columns the strongly self-fertile kinds on the one hand, and on the other the imperfectly self-fertile and the self-sterile kinds. In all tests which have been made as to their self-fertility, when the vines were in normal condition, the former have on the average given marketable clusters, while the latter have given on the average either imperfectly filled clusters or none.

In grouping the varieties so as to show their relative blooming season they have been classed as "very early," "medium early," "mid-season," "medium late," "late" and "very late." These lists do not show the relative season of ripening.[14] There is no marked line of separation between the groups below. Many of the varieties extend their period of blooming into the period of the next later group, so that it is not always necessary, in arranging the varieties for planting, to follow the classification rigidly.

TABLE IV.— GRAPES CLASSIFIED ACCORDING TO THEIR BLOOMING SEASON.

[This table shows in parallel columns lists of grapes which bloom at approximately the same time. The names of strongly self-fertile kinds appear on the left, and those of imperfectly self-fertile and self-sterile kinds, on the right.]

STRONGLY SELF-FERTILE.	SELF-STERILE AND IMPERFECTLY SELF-FERTILE.
BLOOM VERY EARLY.	
Clinton.	Clevener.
Janesville.	Marion.
Mary Favorite.	

14 After Bulletin 157 was issued, several inquiries came to the Station, which showed that some readers supposed that the lists therein given to show the season of blooming, also indicated the relative time of ripening, but such is not the case. Some of the very earliest in blooming, as, for example, the Clinton, are late in ripening.

Table IV.— *Continued.*

Strongly self-fertile.	Self-sterile and imperfectly self-fertile.
Bloom medium early.	
Bell.	Beagle.
Berckmans.	Elvibach.
Brown.	Faith.
Canada.	Helen Keller.
Caywood, No. 50.	Noah.
Champion.	Pearl.
Cottage.	White Jewel.
Early Market.	Woodruff.
Elvira.	
Etta.	
Eumedel.	
Kensington.	
Lucile.	
Lutie.	
Perkins.	
Presley.	
Ulster.	
Bloom mid-season.	
Alice.	Adirondack.
Ambrosia.	Alexander Winter.
Antoinette.	Amber.
Arkansaw.	Amber Queen.
Bertha.	Aminia.
Chandler.	Barry.
Chautauqua.	Creveling.
Colerain.	Daisy.
Columbian Imperial.	Dracut Amber.
Concord.	Eumelan.
Diana.	Grein Golden.
Early Ohio.	Herbert.
Early Victor.	Hercules.
Esther.	Jewel.
Glenfeld.	Juno.
Golden Grain.	Lindley.
Hartford.	Maxatawney.
Herald.	Merrimack.
Highland.	Montefiore.
Isabella.	Northern Muscadine.
Isabella Seedling.	Red Bird.
Jessica.	*Rogers* No. 5.
Lady.	Salem.
Lady Washington.	*Thompson* No. 5.

TABLE IV.— *Continued.*

BLOOM MID-SEASON — *Continued.*

STRONGLY SELF-FERTILE.	SELF-STERILE AND IMPERFECTLY SELF-FERTILE.
Leavenworth.	Vergennes.
Lindmar.	Wilder.
Little Blue.	Wyoming.
Mabel.	
Martha.	
Missouri Riessling.	
Monroe.	
Mills.	
Moore Early.	
Niagara.	
Pocklington.	
Prentiss.	
Profitable.	
Rochester.	
Rockwood.	
Rogers No. 13.	
Rogers No. 24.	
Rogers No. 32.	
Shelby.	
Shull No. 2.	
Standard.	
Superb.	
Telegraph.	
Victoria.	
Winchell.	
Worden.	

BLOOM MEDIUM LATE.

Agawam.	Aledo.
Brilliant.	Black Eagle.
Catawba.	Blanco.
Centennial.	Brighton.
Delaware.	Burnet.
Diamond.	Canonicus.
Duchess.	Denison.
Edmeston No. 1.	Eldorado.
Empire State.	Essex.
Hopican.	Gærtner.
Illinois City.	Geneva.
Iona.	Gold Dust.
Leader.	Hayes.
Livingston.	Massasoit.
Marvin Seedling.	Norwood.
Mathilde.	Oneida.

TABLE IV — *Concluded.*

BLOOM MEDIUM LATE — *Continued.*

STRONGLY SELF-FERTILE.	SELF-STERILE AND IMPERFECTLY SELF-FERTILE.
Olita.	Red Eagle.
Paradox.	Requa.
Paragon.	Roenbeck.
Poughkeepsie.	Roscoe.
Rommel.	Rustler.
Rutland.	*Thompson* No. 7.
Wheaton.	
Witt.	
BLOOM LATE.	
Big B. Con.	America.
Collier (Dr.).	Hexamer (Dr.).
Croton.	
Early Golden.	
Jefferson.	
Metternich.	
Norton.	
Opal.	
Senasqua.	
Triumph.	
BLOOM VERY LATE.	
Bailey.	Big Hope.
Big Extra.	
Carman.	
Elsinburg.	
Fern Munson.	
Hopkins.	

COMMON DISEASES AND INSECTS INJURIOUS TO FRUITS.*

S. A. BEACH, V. H. LOWE AND F. C. STEWART.

INTRODUCTION.

The purpose of this bulletin is to furnish the fruit-grower with a concise account of the common diseases and insects most injurious to cultivated fruits in New York State and to present up-to-date directions for fighting them most efficiently and economically. The accompanying index makes it easy to find any subject treated in the bulletin.

The preparation of spray mixtures and the apparatus for applying them are not treated here because they are discussed at length in Bulletin 121 and its appendix. Both Bulletin 121 and this bulletin should be preserved for reference.

The various fruits are taken up in alphabetical order and under each one the diseases are first considered, then the insects. In the consideration of each particular disease or insect, it is the general plan of the bulletin to give first, one or more descriptive paragraphs setting forth its general appearance, the chief features of its life-history and its economic importance. Then follows a statement of the remedial or preventive treatment which is recommended or suggested by the authors. Where nothing can be positively recommended, suggestions are made, pointing out what appears to be the most promising line of treatment. Recommendations quoted from other authors are given on their authority.

In some instances it is possible to combat various diseases and insects with one general line of treatment. In such cases the

* Reprint of Bulletin No. 170.

general treatment which is advocated is stated after the several diseases and insects have received individual consideration.

APPLE DISEASES.

APPLE TREE CANKER.

(*Sphaeropsis malorum* Pk.)

The term canker, as applied to diseases of trees, is used to designate an injury that destroys the bark and lays bare portions of wood. It has been discovered that a canker which is doing serious damage to apple orchards of this State, is caused by the fungus, *Sphaeropsis malorum* Pk. This is the same fungus that causes the black rot of apple, pear and quince fruit. The disease usually attacks the larger limbs where it may be detected by the swollen appearance of the limbs, the rough, black bark, and in many instances bare wood, black and decaying. The area of bare wood is, in many instances, not large, but the extent of rough, swollen bark may be several feet. The wounds and unhealthy bark interfere with the circulation of the sap and where a majority of the limbs are attacked the tree is greatly enfeebled and may die from the effects.

Some varieties, as the Esopus Spitzenburg and Twenty Ounce, are very susceptible to the attacks of this fungus, and many other common sorts are by no means exempt.

Treatment.— No experiments in treating this disease have, as yet, been completed; therefore, no definite line of treatment can be given. The following suggestions are based on observations and studies of the disease as it occurs in a large number of orchards: (1) Remove all diseased limbs wherever practicable. (2) When spraying with Bordeaux mixture for apple scab pay special attention to coating the limbs with the mixture as well as the leaves and fruit. An earlier treatment given when the leaf-buds are beginning to open may also be advisable. (3) In some instances it will probably pay to scrape or cut the diseased bark from the canker spots and scrape the rough bark from other por-

tions of the tree. The trunk and larger limbs may then be washed with thick Bordeaux mixture or with one of the washes that are recommended for this purpose. The following formula is given as a type of these washes, as it contains the important ingredients:

WASH FOR TREE TRUNKS.

Whale oil soap	1 pint.
Slaked lime	3 pints.
Water	4 gallons.
Wood ashes	To thicken as desired.

Dissolve the soap in hot water, then stir in the lime. When the ingredients have been reduced to a smooth state by stirring, dilute with water to four gallons, then stir in wood ashes till the wash is of the desired consistency.

FIRE BLIGHT.

The same as the "Fire Blight of the Pear" discussed on page 443.

FLY SPECK.

(*Leptothyrium pomi* (Mont. & Fr.) Sacc.)

This disease, although commonly associated with sooty blotch, on both apples and pears, is probably distinct from it. It appears as groups of black dots resembling large fly specks. The specks are not caused by any insect but by a fungus which, like the sooty blotch fungus, is confined exclusively to the surface of the fruit.

The treatment for fly speck is the same as for sooty blotch. See page 405.

LEAF-SPOT.

(*Phyllosticta* spp.)

Description.—This disease is caused by two very closely related species of fungi. It attacks only the foliage. Very soon after the buds break, the young leaves show small, reddish-brown spots. As the leaves grow, the spots enlarge. When the leaves are full grown the spots are brown, brittle, circular, with sharply defined outline, and vary in diameter from one-twelfth to one-fourth of

an inch. In July, several black specks of the size of a small pin head appear at the center of some of the spots, on the upper side of the leaf. Many spots, however, never show the black specks.

Affected leaves fall prematurely. In severe attacks the trees may be almost completely defoliated by July 1. The disease is most troublesome in wet seasons. It is more prevalent on Long Island and in the Hudson Valley than in other parts of the State.

Treatment.— Leaf-spot is only partially prevented by the treatment recommended for scab. See page 404. Where the disease is troublesome we suggest that this treatment be preceded by a spraying with Bordeaux mixture (1-to-11 formula) just as the buds show green at the tips.

RUST.

(*Gymnosporangium* spp. Syn. *Roestelia* spp.)

Description, etc.— Rust is a disease in which circular, orange-colored spots about one-fourth of an inch in diameter appear on the leaves in June. It also produces yellow spots on the fruit at about the same time.

It may be caused by several species of fungi belonging to the genus *Gymnosporangium.* The species of this genus are peculiar in that in one stage of their life cycle they live upon the apple and some other closely related plants, while in another stage they inhabit the red cedar and its relatives. *Gymnosporangium macropus* is the most common cause of apple rust. Its other stage occurs on the red cedar where it produces the so-called cedar apples.

In New England and some parts of the South apple rust is a destructive disease, but in New York it is of rare occurrence except on Long Island. Some varieties are attacked much more severely than others. Rust should not be confused with russeting.

Treatment.— Rust is difficult to combat. Spraying seems to check it but little. Since the red cedar harbors one stage of the fungus which is the chief cause of rust, it is good policy to destroy, so far as practicable, all red cedars in the vicinity of the orchard.

RUSSETING AND BELTING OF FRUIT.

Description.— Both apples and pears are subject to a trouble known as russeting or belting. It is sometimes also called rust, but this name is objectionable because it leads to confusion with the true apple rust discussed above which is a very different thing.

Fruits entirely sound and perfect in form may show areas on which the skin is rough, brown and corky. These areas may be irregular in outline, in which case the fruit is said to be russeted, or they may form a definite zone around the fruit producing the condition known as belting.

Cause.— This trouble is not caused by any insect or fungus. It is due to some irritation of the skin of the fruit, and may be brought about in three principal ways:

(1) By the occurrence of long continued cloudy, wet weather immediately after the setting of the fruit;

(2) By spraying with Bordeaux mixture during cloudy, wet weather;

(3) By the freezing of dew on the fruit while it is young and tender. In this case the injured area usually takes the form of a zone or belt.

No remedy is known.

SCAB.

(*Venturia inæqualis* (Cke.) Aderh.[1])

Description.— The worst disease with which the apple growers of this State have to contend is one commonly known as "apple scab" or "cracking of the apple." It is caused by a fungus which attacks the skin of both foliage and fruit.

On the fruit the spots at first usually circular in outline and have a very dark velvety-green surface, but afterwards they become nearly or quite black. In some cases the diseased tissue finally scales off leaving a scar with a corky, russet surface. The

[1] This is the name given to the ascosporic stage of *Fusicladium dendriticum* (Wallr.) Fckl.

spots vary in size from small dots to the large irregular patches which are formed when two or more smaller spots coalesce. Where the spots are large the fruit may become one sided or otherwise distorted, and often it cracks open. For this reason the disease is sometimes called "the cracking of the apple."

On the leaves the fungus has the appearance of a dark mold. It is found in spots on both the upper and under surfaces. The disease may cause the leaves to be much crumpled and finally show brown, dead tissue which breaks away leaving the foliage torn and ragged, or the entire leaf may drop off.

Some varieties are especially susceptible to its attacks, and it is not unusual to see a very large proportion of their fruit badly cracked by it. On the other hand, there are varieties which are generally quite resistant, on which the scab spots increase comparatively slowly, and the cracking of the fruit is seldom or never seen.

On the fallen leaves of the previous season, there develop, in the spring, perithecia within which are perfected spores for the propagation of the fungus.[2] The fungus is known to begin its attacks very early in the season, for occasionally it may develop sufficiently to be discovered by the naked eye on unopened blossom buds. In seasons especially favorable to its early development it has been observed to cause great injury early in the season, destroying the blossoms and the young fruit. In order to control the disease, therefore, it is important to begin treatment early. It must be borne in mind that the treatment is effective by preventing the germination of the spores rather than by killing the fungus after it has become established either on the foliage or on the fruit.

Treatment.— The scab may be controlled by proper spraying with Bordeaux mixture. Fortunately these treatments may be combined with others which are advocated by the Entomologist

[2] Aderhold, Dr. Rud. Die Fusicladien unserer Obstbäume, I. Theil Landw. Jahrbücher, 25: 880–914, 1896.

against the case-bearers, bud moth, canker worm, codling moth and other injurious insects. The combined treatment advocated for scab, leaf-spot, canker disease, codling moth, canker worms, and various other insects is given on page 417. As there stated, the scab may generally be controlled by three applications of the Bordeaux mixture if made at the proper time, and very thoroughly. Where but three treatments are given, the first spraying should be made after the buds break but before the blossoms open; the second, just after the blossoms fall; and the third, from ten to fourteen days after the second.

Winter treatment for apple scab.— Spraying for apple scab while the buds are dormant has not been found profitable. The later treatments advocated above *must* be made in order to control the disease. When these are made the winter treatment does not bring sufficient additional benefit to justify the expense of making it against the scab alone, but it may pay when directed also against the canker disease and combined with some application which must be made against insects such as case-bearers or bud moth.

It is known that the scab fungus lives during winter on the fallen leaves and in the spring produces spores by means of which it spreads to the new foliage. Probably it may exist during winter to some extent on the bark of young twigs, also. Granting that this is the case and that a large part of the fungus on the tree is killed by winter treatment, which is improbable, it is evident that when the new foliage appears it must be covered with some fungicide to protect it from the spores produced on the fallen leaves. The fruit grower should direct his efforts toward preventing the germination of the fungus spores on the foliage, rather than attempt to kill the fungus in winter quarters. The Bordeaux mixture treatment is a preventive rather than a cure.

SCALD.

Stored fruit of some varieties of apples, notably Rhode Island Greening, sometimes becomes discolored and presents an appear-

ance which is commonly called "scald." It is not caused by any fungus. Jones[8] has made some investigations concerning the cause of scald. The following account is based on his reports.

Description.— The scald first appears as a light brownish tinge of the skin either in fairly well defined spots or more or less diffused. The discolored areas enlarge with more or less rapidity coalescing until the entire surface of the apple may be involved. At the same time the color changes from a lighter to a darker brown shade and usually terminates in a black rot. At the beginning of the trouble the flesh appears sound, the discoloration involving only the outer cells of the fruit. Afterwards, the flesh also becomes discolored and is finally invaded, in most cases, by some fungus, but the primary cause of the scald cannot be attributed to any fungus or other parasite.

It appears certain that the primary cause of the scald is to be found in climatic and orchard conditions, the conditions of the storehouse being secondary. The fruit which is grown and matured under favorable conditions can be carried through the normal season of keeping for fruit of that variety without the appearance of the scald. If grown under unfavorable conditions the fruit requires very careful attention to the temperature and perhaps other store-room conditions if it is kept for any length of time without scalding.

SOOTY BLOTCH.

(*Phyllachora pomigena* (Schw.) Sacc.)

Description, etc.—In wet seasons and especially in damp, shady situations, apples are subject to the attacks of the fungus which causes sooty blotches on the fruit. These blotches are sooty-black, circular, and measure from one-fourth to one-half an inch in diameter. Frequently the blotches coalesce, giving the fruit a sooty, dirty appearance.

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[8] Jones, L. R. Vt. Agr. Exp. Sta. Ann. Rept. 1896–1897: 55–59 and 1897–1898: 198.

Sooty blotch is sometimes mistaken for scab. A striking point of difference between the two diseases is the manner in which they attack the fruit. Sooty blotch is confined to the surface of the fruit and may be readily removed by rubbing, while the scab destroys the cuticle (outer layer of the skin) thus making a spot which cannot be removed by rubbing.

Being superficial in its growth, the fungus does the fruit no harm except to make it unsightly and, consequently, less salable.

Under favorable conditions sooty blotch may appear upon almost any variety, but it seems to have a preference for some of the fair skinned varieties such as Bellflower, Fall Pippin and Rhode Island Greening. Pears, also, are subject to it.

Treatment.— In orchards sprayed for apple scab the fruit will not, ordinarily, suffer much either from sooty blotch or the fly speck disease. However, for the best results with both of these diseases it seems necessary to make one or two sprayings in July in addition to those made in treating apple scab.

APPLE INSECTS.

BORERS.

Several species of borers attack the apple tree. As a rule they will be found in the trunk, but occasionally in the larger limbs. A small species sometimes infests the twigs. The presence of the grubs is usually indicated by the discolored bark and by their castings. The following species are most commonly met with in this State:

THE FLAT-HEADED APPLE-TREE BORER.

(*Chrysobothris femorata* Fab.)

Description.— The female beetle lays its eggs in the bark late in June or in July. These hatch in a few days and the grubs at once gnaw their way into the sap-wood where they live and feed from one to three years before reaching full size. A short time before pupation they go deeper into the solid wood. The adults

are steel-colored beetles, flattened above and with irregular depressions on the wing covers.

Treatment.— The trees should be examined at least once a year and the borers dug out with a knife or killed by inserting a flexible wire into the burrows.

THE ROUND-HEADED APPLE-TREE BORER.

(*Saperda candida* Fab.)

Description.— The life-history of this species is similar to that of the preceding except that the grub requires but about a year to reach full growth. In both the grub and adult stages the body is more nearly cylindrical in outline. The adult is prominently marked by two broad, nearly parallel, white lines extending the full length of the body.

Treatment.— The same as for the preceding species.

LEAF-EATING INSECTS.

THE APPLE-TREE TENT CATERPILLAR.

(*Clisiocampa americana* Harr.)

Description.—This tent caterpillar feeds upon a variety of fruit and other trees and is especially injurious to the apple. The eggs are laid in July in conspicuous brown rings or masses about the smaller twigs. The caterpillar is developed in the egg in the fall but does not emerge from the egg shell till early in the following spring. The caterpillars from each egg mass form a colony and spin a tent in which they stay when they are not feeding on the leaves of the tree.

After they are full grown, that is about five or six weeks after hatching, they spin their cocoons. The adults, which are brown moths, with two, oblique, parallel white lines on the fore wings, emerge in the latter part of June or early in July.

Treatment.— The egg masses may easily be gathered in winter and burned. The caterpillars may be destroyed while in their

nests or by applying a poisonous spray to the foliage. It is easier to kill the caterpillars by spraying when they are very small than it after they have become large. It is important, therefore, to make the first spraying just before the blossoms open because that is about the time the caterpillars emerge from the egg. The cocoons are quite conspicuous and their destruction will aid materially in lessening the numbers of females to lay eggs.

For further information relative to these insects and their near relatives, the forest tent-caterpillars, which are sometimes injurious in orchards, consult Bulletins 152 and 159 of this Station.

BUD MOTH.

(*Tmetocera ocellana* Schif.)

Description and life-history.— The young of the bud moth are small brown caterpillars about half an inch in length. During the winter they live in small, oval, silken cases, attached firmly to the bark of the twig. As the caterpillars are very small when winter sets in, about one-eighth of an inch in length, their silken cases are also small and hence easily overlooked. During this period of their lives the caterpillars are green in color.

About the time that the buds begin to swell in the spring, the caterpillars come forth and bore into them, thus early protecting themselves against insecticides. As the young leaves and flowers unfold the caterpillars form nests for themselves by tying the leaves together, making their presence quite conspicuous. They do not leave these nests in feeding. During June they reach full growth and change to the chrysalis stage in the nest. In about ten days a small brown moth escapes. This is the adult. The eggs are laid on the under side of the leaves. These soon hatch and the young caterpillars feed on the under sides of the leaves, protecting themselves by a thin, silken web. Before winter approaches they migrate to the twigs and form the silken cases in which, as above stated, they live over winter.

Treatment.— The only available time for effective treatment is just before the buds begin to swell, the object being to cover the buds with poison so that the young caterpillars will be poisoned as they gnaw into the bud. To make the work thorough, two applications will usually be required. Paris green or some other good arsenical should be used. If it is desired to treat the trees for apple scab, Bordeaux mixture may be combined with the Paris green for either of the above treatments. See page 417.

CASE BEARERS.

PISTOL-CASE-BEARER.[4]	CIGAR-CASE-BEARER.
(*Coleophora malivorella* Riley.)	(*Coleophora fletcherella* Fern.)

During the past three or four years these two insects have become very troublesome in this State. Their principal food plant is the apple, but they also feed upon the pear and quince and probably other fruit trees. The life histories of the two species are very similar. That of the pistol-case-bearer is as follows:

Descriptions and life history.—The young caterpillars live over winter in little pistol-shaped cases of silk which are attached on end to the twigs usually near and sometimes upon the buds. These cases measure about one-eighth of an inch in length and resemble the bark in color. The winter cases of the cigar-case-bearer are more flattened laterally and are somewhat crescent shaped. They are also lighter in color and are more frequently found in sheltered places in the angles of the twigs.

Early in the spring, a short time before the leaf buds burst, the hibernating case-bearers become active. They attack the growing buds gnawing through the outer covering to feed on the tender tissues beneath. Later in the season they feed on the young leaves making small round holes through the cuticle and feeding, in much the same manner as a true leaf miner, on the softer tissues beneath. In doing this the caterpillars do not usually leave their cases but reach out as far as necessary. As they

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[4] This species is discussed in detail by Lowe, in Bulletin 122 of this Station.

become larger and stronger they devour the entire leaf with the exception of the midrib and large veins. They also attack the flower buds, flowers and fruit.

About the middle of May the case bearers have become full grown and are ready to pupate. They have enlarged their houses as their growing bodies demanded until now the cases measure about one-fourth of an inch in length. The case-bearers migrate to the twigs and attach their homes firmly on end to the bark. Before the transformation to the pupa stage takes place the caterpillars turn around in their cases so that their heads are toward the upper or curved ends. The pupa stage lasts about two weeks.

The principal difference in appearance between these two species is apparent at this time. The case of the cigar-case-bearer is straight and closely resembles a miniature cigar; while, as previously stated, that of the pistol-case-bearer slightly resembles an old fashioned pistol.

The adults of both species are moths measuring about half an inch from tip to tip when the wings are spread. The color of the former is steel gray, the latter is marked with brown. The moths appear during the latter part of May or early in June. The eggs of both species are deposited singly on the under sides of the leaves. They hatch in about ten days or two weeks. The young caterpillars feed on the tender pulp of the leaf. During September they migrate to the smaller branches and twigs, to remain until spring. Thus there is but one annual generation.

Treatment.— For general treatment advocated against these insects see page 417. The first treatment is of especial importance, the object being to have the buds coated with poison so that the first meal of the little caterpillars will be a poisoned one. A second application may be made just as the leaves unfold and a third if needed.

CANKER WORMS.

Although there are several species of canker worms quite common to the apple orchards of the State there are but two species

that often occur in sufficient numbers to do serious injury. These are the spring canker worm (*Paleacrita vernata* Peck) and the fall canker worm (*Anisopteryx pometaria* Harr.) The former is the more common and injurious of the two. The life histories of the two species are very similar except that the eggs of the spring canker worm are laid in the spring and those of the fall canker worm in the fall. The eggs of both species hatch in the spring about the time the leaf buds are unfolding.

Descriptions.— The eggs of the former species are placed somewhat promiscuously in sheltered places on the twigs. They are small oval eggs and the shell has a brilliant pearly luster. The eggs of the latter species are placed on end side by side in quite regular masses. They are somewhat cylindrical but smaller at the base and flattened at each end.

When first hatched the caterpillars of both species are very small and of a light green color. They devour the leaves rapidly. When disturbed they will drop, suspending themselves by silken threads. When mature they are about an inch long and vary in color from light green to darker shades. When ready to pupate they go into the ground, where the cocoon is spun and the chrysalis formed. Most of the spring canker worms remain in the ground until the first warm days of the following spring, but those of the other species come out of the ground in the fall. The adults of both species are moths. The females are wingless and the males winged.

Treatment.— There are two principal methods of combating these insects. First the females may be trapped while endeavoring to ascend the trunk of the tree. Numerous traps have been tested including bands of tin, cloth, waste wool, tarred paper and certain chemical preparations. Several patent metal devices for trapping the moths have been put upon the market recently. The most important point in connection with the use of traps in general is to put them on early in the season. It is usually advisable to put the metal traps in place early in the fall to catch the

moths of the fall canker worm. They will then be in place for the earliest moths of the spring species.

Second, the caterpillars may be successfully combated by spraying the trees with Paris green or some other equally effective arsenical insecticide. See page 417. Two and occasionally three applications are usually necessary. Make the first application just as the young leaves are unfolding, and the second about a week later.

Regular annual spraying with a good arsenical compound is especially important in this case. Orchards thus treated are not as likely to become seriously infested with these and other leaf eating insects as the orchards which are sprayed irregularly or not at all.

FRUIT INSECTS.

CODLING MOTH.

(*Carpocapsa pomonella* Linn.)

Descriptions.— This is the insect that causes " wormy " apples. The recent investigations of Washburn, Card and Slingerland have thrown new light on certain stages of its life-history. It is now known that the eggs, which are whitish, oval discs, may be laid promiscuously upon the fruit or even upon the twigs and leaves. It is probable that they are not laid until after the blossoms have fallen. The period of incubation is about a week.

According to Slingerland[5] about 75 per ct. of the caterpillars enter the fruit at the blossom end. The caterpillars of the second brood often enter on the side of the fruit. They are full grown in twenty to thirty days. When once within the fruit they usually remain until ready to pupate. The cocoons are made in any convenient, protected place, as under the loose bark of the trunk or larger branches of the tree, or in near-by rubbish. Some of the caterpillars remain in the cocoons over winter, while others soon transform to the pupa stage forming a more or less complete sec-

[5] Cornell Univ. Agr. Exp. Sta. Bul. 142: 21.

ond brood. These are sometimes very abundant in late summer and in autumn. The adult is a small brown moth measuring about ¾ of an inch from tip to tip when the wings are spread.

Those who wish an exhaustive treatise on this insect should consult Prof. Slingerland's bulletin.[6]

Treatment.—A considerable percentage of the worms can be killed by spraying within the first week after the blossoms have fallen. The calyx end of the fruit must be filled with the poison before the calyx lobes close, hence much pains should be taken to make at least one thorough application before that occurs.

GREEN FRUIT WORMS.

(*Xylina* sp.[7])

Descriptions.— These insects sometimes do serious injury by eating into the young apples. They also attack pears, plums, peaches and quinces. The full-grown caterpillars measure from an inch to nearly an inch and a half in length. They are green or yellowish green in color with various irregular markings and stripes, the most prominent of the latter being a narrow, cream-colored one down the middle of the back and a wider one along each side.

The caterpillars are most abundant during May, soon after the fruit has formed. They continue feeding until about the middle of June. They feed mostly at night, resting on the under sides of the leaves during the day. When full grown they go into the ground, form a rough cocoon and pupate. The adults, which are dull-colored moths measuring about two inches from tip to tip with the wings spread, come forth in the fall and remain over winter in some sheltered place, laying their eggs in the spring.

Treatment.— These insects have proven difficult to control. Experiments by Lowe with Paris green, one pound to 100 gallons of water, applied to the infested trees when the caterpillars

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6 Loc. cit.

7 For a more complete account of these insects, see Cornell Univ. Agr. Exp. Sta. Bul. No. 123, by M. V. Slingerland.

were about half grown, gave very unsatisfactory results. It is not improbable, however, that had the experiments been made earlier while the caterpillars were small the poison would have had more effect. Where practical, as in the case of small trees, the caterpillars may be jarred off in the same manner as the plum curculio.

MAGGOT.

(*Rhagoletis pomonella* Walsh.)

Description.— This insect is popularly known as the "apple maggot" or "railroad worm." It is one of the most important species that attacks the fruit. Its life-history has been fully worked out by Dr. F. L. Harvey.[8] The adult insects are two-winged flies. They appear in June. The female punctures the skin of the fruit with her sharp ovipositor and lays her eggs just beneath. In a few days the eggs hatch into white maggots which make numerous irregular channels in the pulp of the apple, enlarging them as the maggots increase in size. This injury often does not show on the outside, and hence infested fruit may be harvested and unintentionally sold as good. Badly infested fruit usually falls early.

The maggots leave the fallen fruit and enter the ground to pupate, remaining until the following spring before emerging as adults.

The apple maggot appears to be spreading in this State, and as it is capable of doing great injury it should be carefully watched for and promptly checked when found.

Treatment.— This insect has proven a difficult one to control. as the maggots work only within the fruit spraying the trees will have no effect. Probably the most practical remedy is the immediate destruction of the windfalls in infested orchards. This may be conveniently done by allowing hogs and sheep to run in the orchards. Fall plowing will have some effect by destroying many of the pupæ in the ground.

[8] Maine Agr. Exp. Sta. Ann. Rept., 1889: 190.

PLANT LICE.[9]

Several species of plant lice attack the apple, but the most common in this State is the apple-tree aphis, *Aphis mali* Fab. This is the little, green louse that attacks the buds and leaves in the spring. It often occurs in great numbers on the under side of the leaves, sucking the sap from the tissues. This irritation causes the leaves to curl, thus affording partial protection to the insects. The winter is passed in the egg stage. Many generations and countless individuals, both winged and wingless, are produced during the summer. They secrete a clear liquid (honey dew) which sticks to the leaves and twigs and finally turns black, because of a black fungus which grows in it.

Treatment.— The trees should be carefully watched, and, when the lice first appear, sprayed thoroughly with a solution of whale oil soap and water — one pound to seven gallons. The lice may appear any time after the buds burst. It is important to give the infested trees at least one or, as is often necessary, two thorough applications before the leaves have become curled. It will be very difficult to reach the lice when they are protected by the curled leaves. The spray should be directed toward the under side of the leaves.

INSECTS ATTACKING TRUNK AND BRANCHES.

THE WOOLLY LOUSE OF THE APPLE.

(*Schizoneura lanigera* Hausm.)

This insect is easily detected by the white wool-like substance which the lice secrete and which clings to their bodies. They attack both the roots and young branches causing gall-like swellings. They are especially injurious to young trees and sometimes do serious injury to new grafts.

Treatment.— When occurring upon the roots considerable relief will usually result from the application of finely ground

[9] For a further discussion of plant lice, see Bulletin 139 of this Station, by V. H. Lowe.

tobacco dust about the infested roots. If the branches also are attacked, they should be trimmed off where practicable and burned. If considered more desirable, the lice may be killed by spraying with a solution of whale oil soap, one pound to five gallons of water, or kerosene emulsion, one part to five parts of water. When but few lice occur in small colonies on the trunk or large branches they may be easily and quickly killed by applying pure kerosene oil to the infested parts.

Some Australian horticulturists hold that injury from the woolly aphis can be avoided by selecting varieties the roots of which are proof against these insects. Wickson states[10] that "the Northern Spy is on the whole the best, but it has been shown that the roots of seedlings grown from Northern Spy seed vary somewhat in degree of resistance."

SCALE INSECTS.[11]

The scale insects include some of the most common and destructive insect pests of the orchard. Two species common in the apple orchards of the State are the oyster-shell bark louse, *Mytilaspis pomorum* Bouché, and the scurfy bark louse, *Chionaspis furfurus* Fitch. The San Jose scale, *Aspidiotus perniciosus* Comst., also attacks the apple. These insects are especially injurious to young orchard trees. The former two species pass the winter in the egg stage, the eggs having been deposited under the scales of the females. The eggs hatch in this climate in the spring, varying according to the season, from late in April or early May until June. The young lice soon settle down and insert their sharp threadlike mouth parts into the tender bark from which they suck the sap. The females form the oyster-shell-like scales, or, in the case of the other species, the thinner, more oval, whitish scales. The scales of the males of both species are more delicate, nearly white, and larger and more slender. The adult males are delicate two-winged insects.

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10 Univ. of Cal. Agr. Exp. Sta. Seed Bulletin, 1898–1899: 7.

11 For a further discussion of these insects, see Bulletin 136 of this Station.

Treatment for oyster-shell bark-louse.—Treatment may be made in the spring by spraying the trees as soon as the eggs hatch, either with whale oil soap, one pound to seven gallons of water, or kerosene emulsion, one part to seven parts of water. One or more applications should be made as required. For treatment of scurfy bark-louse, see page 450, and for San Jose scale page 449.

GENERAL TREATMENT AGAINST DISEASES AND INSECTS WHICH ATTACK THE APPLE.

When to spray.	What to use and what the treatment is for.
1. Just before leaf buds burst........	Paris green[12] against bud moth and case-bearers.
2. Just as leaf buds show green at the tips. About a week later than 1.	Bordeaux mixture[13] against scab, canker disease and leaf spot. Paris green[12] against bud moth, case-bearers, canker worms, tent caterpillar and various other leaf-eating insects.
3. Just before blossoms open. From seven to ten days later than 2.	Bordeaux mixture[13] against scab and leaf-spot. The most important single application. Apply thoroughly. Paris green[12] against canker worms, tent caterpillar and various other leaf-eating insects.
4. Just after blossoms fall..........	Bordeaux mixture[13] against scab and leaf-spot. A very important application; make it promptly and thoroughly. Paris green[12] against codling moth, canker worms, tent caterpillar and numerous other leaf-eating insects. The most important application against codling moth.
5. From ten to fourteen days after 4.	Bordeaux mixture[13] against scab and leaf-spot. If weather has been cool and wet, apply with especial thoroughness. Paris green[12] against codling moth.

[12] Paris green should be used at the rate of one pound to 150 gallons of water. If used alone, about two pounds of fresh slaked lime should be added to make it adhere and to prevent injury when applied to foliage. Green arsenite of copper, arsenite of lime, or other poison may be used instead of the Paris green, as directed in Bulletin 121. Paris green or the other arsenicals may be used with Bordeaux mixture. In that case, it is not necessary to add much extra lime.

[13] Use Bordeaux mixture 1-to-11 formula. Pure copper sulphate solution, 1 pound to 15 gallons or more, may be used when there is no foliage. It is cheaper, but does not adhere so well as does Bordeaux mixture. Directions for making and applying these mixtures are given in Bulletin 121. The Paris green or other arsenicals may be mixed with the Bordeaux mixture, and both may be thus combined in one application.

Generally, the scab may be controlled by three treatments if they are made promptly and very thoroughly. These three, as numbered above, are 3, 4 and 5. Winter treatment against the scab is not recommended. See page 404.

For treatment of lice or aphis, scale insects, rust, sooty blotch and fly speck consult the special discussion of these subjects on previous pages.

APRICOT DISEASES.

FRUIT ROT.

The ripe rot of apricot fruit is due to the same fungus as that causing ripe rot of cherries. It is discussed on page 420.

LEAF-SPOT.

(*Cylindrosporium padi* Karst.)

The fungus which causes apricot leaf-spot also causes a spotting of the fruit. When the leaves are attacked the diseased part usually drops out leaving a clean cut hole. In severe attacks the foliage is riddled with holes. The same fungus also attacks the foliage of plums and cherries. For the treatment, see plum leaf-spot, page 454.

GUMMING.

See discussion of the gumming of stone fruits, page 438.

APRICOT INSECTS.

CURCULIO.

This insect does great damage to apricots by causing wormy fruit. Frequently a large part of the crop becomes infested and drops unless measures are taken to kill the beetles before they deposit their eggs in the young fruit. This is best done by jarring as recommended in the discussion of this insect under the heading "Plum curculio." It is very important that the jarring begin *as soon as the fruit sets,* because the curculios do much injury to the very young apricots.

The other insects mentioned as attacking the peach are also liable to trouble the apricot.

BLACKBERRY AND DEWBERRY DISEASES.

ANTHRACNOSE.

Blackberry anthracnose is caused by the fungus which affects raspberries in a similar way. For description and treatment, see page 459.

LEAF-SPOT.

(*Septoria rubi Westd.*)

Description.— Blackberries, dewberries and raspberries are subject to a leaf-spot disease caused by *Septoria rubi*. The small, pale spots of dead leaf-tissue finally become dotted with black specks, the pycnidia of the fungus. In some seasons the foliage is quite seriously injured by this disease.

Treatment.— Goff[14] has tried treatment with Bordeaux mixture and other fungicides, but the results were not encouraging. No successful line of treatment is known.

RUST.

Blackberry rust is caused by the same fungus which causes the rust of raspberries. For description and treatment, see page 460.

BLACKBERRY AND DEWBERRY INSECTS.

The principal injurious insects of blackberry and dewberry are the cane borer and the saw fly. These also attack the raspberry. They are discussed on pages 461, 462.

CHERRY DISEASES.

BLACK KNOT.

It is claimed that the black knot of the cherry is caused by the same fungus as that which causes the black knot of the plum. If it is not the same fungus it certainly is so closely related that the

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[14] Goff, E. S. Journ. Myc., 7: 22.

same description of gross characters and the same lines of treatment will apply to both. For description and treatment, see "Plum black knot," page 452.

FRUIT ROT.

(*Monilia fructigena* P.)

Description.— The rotting of the ripening fruit on the tree often causes great injury to the crops of cherries, plums, apricots and peaches. A fungous parasite attacks the fruit and causes it to rot. The same fungus under favorable conditions, especially when the weather is warm and moist, and the growing shoots are tender and succulent, may attack the ends of the twigs and also the blossoms. Frequently the rotted fruit remains on the tree over winter in a mummied form and the following season, under favorable weather conditions, becomes covered with spores by means of which the disease is propagated. These mummied fruits, therefore, should be collected and destroyed before growth starts in spring, as a preventive of infection.

The fungus sometimes does considerable damage by destroying the blossoms, but usually it causes most loss by attacking the fruit. It occurs on unripe fruits, but usually spreads most rapidly and does most damage when the fruits are nearly or quite ripe, especially if they hang in clusters or touch each other. Under weather conditions very favorable to its growth it may practically ruin the ripening crop within a short time.

Treatment.— The disease may be prevented to some extent by treatment with fungicides, but it is extremely doubtful whether it can be entirely controlled by spraying. Bordeaux mixture applied soon after the fruit sets persists, to some extent, until the fruit ripens and will show on the ripe fruit. The other mixtures which have been tried are of doubtful utility, taking all things into consideration. For both this disease and the leaf-spot it is suggested[15]

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[15] Beach, S. A. N. Y. Agr. Exp. Sta. Bul. 117: 134.

that the trees be sprayed just before blossoming and again immediately after the blossoms fall, but no line of treatment is recommended.

Powell[16] recommends picking the fruit before it is fully ripe; that is, before it softens.

LEAF-SPOT.

(*Cylindrosporium padi* Karst.)

Description.— The leaf-spot of cherry, plum and apricot, which is caused by the fungus named above, at first appears as minute spots on the leaf, a sixteenth of an inch or less in diameter. On cherry and plum especially, the spots may have a reddish-tinged margin. Afterwards they increase in size and may enlarge to an eighth of an inch or more across. The spots soon become dark brown with a pale center, and in many cases the diseased tissue loosens and drops out leaving a clean-cut hole in the leaf. For this reason the disease is sometimes called the "shot-hole disease."[17] The disease may cause serious injury for sometimes the trees are nearly defoliated by it. Should this occur when the trees are heavily loaded with fruit, as it is especially apt to do with plums, the trees may be much weakened in vitality[18] and consequently more liable to winter injury.

Treatment.— It has been shown conclusively that the leaf blight may be controlled by proper treatment with Bordeaux mixture but in cherry orchards the treatments cannot be made at the most favorable time for controlling the disease because the spray mixtures adhere to the fruit and injure its market value.[19] From our present knowledge of the subject no line of treatment can be positively recommended for bearing cherry trees, but it is sug-

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16 Powell, G. Harold. Del. Agr. Exp. Sta. Rept. 1897: 193.

17 Duggar has shown that a shot-hole appearance in plum and peach foliage is not always due to fungous attacks, but may be caused by other injuries, notably by spraying with improperly prepared mixtures. See Proc. Soc. for Promotion Agr. Science, 1898, and Cornell Agr. Exp. Sta. Bul. 164: 385.

18 Beach. Annual Rept. this Station, 1896: 385; also Bulletin 98.

19 Beach. Annual Rept. this Station, 1896: 406.

gested that Bordeaux mixture (1-to-11 formula) be applied just before the blossoms open and again just after they fall as a partial preventive of leaf-spot and fruit rot.

GUMMING.

See discussion of gumming of stone fruits under gumming of the peach, page 438. To prevent gumming in the forks of cherry trees Wickson[20] advocates training the tree in such a way as to give wide, open forks where the branches join the trunk.

CHERRY INSECTS.

CURCULIO.

This insect injures cherries by causing the fruit to become wormy. It is the same insect as the plum curculio and is discussed more at length under the subject "Plum curculio," on page 454.

Treatment.— The curculio is commonly fought in cherry orchards by one or two applications of Paris green or its equivalent at the rate of one pound to three hundred gallons of water. Two or three pounds, at least, of unslaked lime should be added for every pound of the poison. Slake the lime and add to the mixture the same as in making Bordeaux mixture. The poison may be mixed with the Bordeaux mixture if desired as stated on page 417. Make the first application immediately after the blossoms have fallen and a second about ten days later.

FRUIT BARK BEETLE.

This is the same as the fruit bark beetle of peach discussed on page 442.

MAGGOT.

(*Rhagoletis cingulata?* Loew.)

This insect resembles the apple maggot in all of its stages. It attacks sour cherries and probably plums to some extent. It has

[20] Wickson, E. J. California Fruits, p. 284.

recently proven a serious pest in some of the large cherry orchards of Western New York. A similar if not identical species occurs in some of the middle and eastern states.

The life history of this insect has not been fully worked out. It is known, however, that the eggs are laid nearly or quite under the skin of the ripe fruit, and that the maggots work in the flesh. In depositing the egg the female makes a small round hole, probably with her ovipositor, through the skin. Until the fruit has been sufficiently eaten to cause decay, this small hole is all there is to indicate that the maggot is inside. For this reason newly infested fruit is often quite difficult to detect. When full grown the maggots leave the fruit, as shown by specimens kept under observation by Lowe, and form the puparium or resting stage in any convenient place, such as the bottom of fruit baskets. If the fruit is on the ground the maggots will go into the ground for a short distance. The adults emerge in the spring early enough to lay their eggs in the earliest varieties of sour cherries. Egg laying probably continues throughout the season of the latest varieties. The number of broods is not positively known. The insect probably winters in the pupa stage.

Treatment.— This species will probably prove, like the apple maggot, a difficult one to control. Good cultivation and keeping the packing houses free from rubbish will undoubtedly have some effect. Lowe found in the infested orchards which he examined that the insect first attacked the fruit on a few trees in one section and gradually spread to other sections of the orchards. This indicates that it spreads slowly, and also that destroying the crop on the few trees that were first attacked, while an heroic measure, would probably be the means of preventing serious infestation of the orchard.

PLANT LICE.

Several species of plant lice attack the cherry. As a rule they do not occur on sour cherry trees in sufficient numbers to do serious injury. Sweet cherry trees, however, are quite frequently attacked by the black cherry aphis, *Myzus cerasi* Fab. The lice

are nearly black in color. Like other species of plant lice they multiply with great rapidity, soon covering the under sides of the leaves and causing them to curl and wilt. The lice prefer the young leaves at the tips of the branches, and will be found there in greatest numbers.

Treatment.— Where practical cut off and burn the ends of the twigs bearing the young and worst infested leaves. The trees should then be sprayed with whale oil soap solution or kerosene emulsion as recommended for the apple plant louse, page 415.

SLUG.

This insect also infests pear trees. It is discussed more fully under the heading " Pear slug " on page 451. The remedies to be used are there given.

CURRANT DISEASES.

LEAF SPOT.

(*Septoria ribis* Desm. and *Cercospora angulata* Wint.)

These two fungous diseases which cause spotting of currant leaves have been successfully treated with Bordeaux mixture by Pammel.[21] The spot diseases are usually seen to some extent each season, and in some cases their attacks are so severe as to nearly defoliate the bushes. Judging from the experiments thus far tried, the spraying should begin soon after the fruit sets, and continue at intervals of about two weeks until the fruit begins to color. One or two applications may be made after the fruit is harvested if thought necessary. One objection to the treatments before the fruit ripens is that the mixture is liable to remain on the fruit and injure its appearance when ripe.

Goff[22] has recently reported excellent results from a single thorough spraying with Bordeaux mixture made during the first week in July, after the fruit was harvested.

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21 Pammel, L. H. Iowa Agr. Exp. Sta. Bul. 13: 45–46; Bul. 17: 419–421; Bul. 20: 716–718; Bul. 30: 289–291.

22 Goff, E. S. Wis. Agr. Exp. Sta. Bul. 72: 30.

CANE BLIGHT.

Description.— This disease is characterized by wilting of the foliage and dying of the canes. Healthy and diseased canes commonly occur in the same hill. The disease may appear at any time during the growing season, but it is most virulent about the time the fruit is ripening. It appears that there are two forms of cane blight. The form occurring in the Hudson Valley[23] is caused by a sterile fungus which works in the pith and under the bark. In the western part of the State there occurs a currant cane blight which, according to Durand,[24] is caused by the semi-parasitic fungus, *Nectria cinnabarina* (Tode.) Fr.

Treatment.— Probably the most practical method of fighting cane blight is to go over the plantation at frequent intervals during the summer and cut out and burn the affected canes. In doing this, care must be taken to cut well below the lowest point of the disease. After cutting into diseased wood the pruning knife should be disinfected before it is used on healthy wood. A 5 per ct. solution of carbolic acid is a good disinfectant for this purpose.

Cuttings should be taken only from plants known to be healthy.

CURRANT INSECTS.

PLANT LICE.

The first indications that the plant lice are at work are the small bladder-like galls on the upper surfaces of the leaves. The galls soon turn red, increase in size and may finally include nearly the entire leaf. The lice congregate in large numbers in the corresponding pockets on the under sides of the leaves. Several species work on the currant, but the most common is the currant plant louse, *Myzus ribis* Linn.

Treatment.— The infested bushes should be sprayed with a solution of whale oil soap, one pound to seven gallons of water. The

[23] For an account of current cane blight in the Hudson Valley, see Bul. 167 of this Station, p. 291.

[24] Durand, E. J. A Disease of Currant-Canes. Cornell Univ. Agr. Exp. Sta. Bul. 125.

first application is the most important, and should be made as soon as the lice appear. The spray should be directed so as to hit the under surfaces of the leaves. A second and third application about a week apart may be necessary.

SAW FLIES.

(*Nematus ventricosus* Klug.) (*Pristiphora grossulariae* Walsh.)

Description.— The first named species, which is popularly known as the imported currant worm, is much more troublesome than the latter, which is a native American species. The larvæ are the common " worms " that attack the leaves of both the currant and gooseberry, often quickly denuding the bush.

The adults are four-winged flies about the size of a house-fly. Their bodies are prominently marked with yellow. They appear during the first warm days of spring and deposit their eggs in single rows on the under sides of the midribs and larger veins.

The eggs hatch in about ten days. The newly hatched larvæ are light green in color. At first they eat small holes through the leaves, but as they grow larger, devour the entire leaf with the exception of the midrib and larger veins. Their color changes with successive molts until, when about full grown and before the last molt, they are a moderately dark green color, marked with numerous black dots. After the last molt they are plain green. When full grown, which is in about three weeks, they measure about three-fourths of an inch in length. The cocoons are formed either just above or a short distance below the surface of the ground, attached to the plant. The adults escape late in June or early in July. Eggs are soon deposited for a second brood, which passes to the chrysalis stage before winter sets in.

Treatment.— As soon as the " worms " appear spray the bushes with hellebore, one ounce to two gallons of water. Direct the spray toward the under sides of the leaves. It is important to make the first application while the " worms " are yet very young.

Otherwise it is more difficult to poison them. If a second application is necessary use an ounce of hellebore to one gallon of water.

GOOSEBERRY DISEASES.

LEAF-SPOT.

The fungi which cause the leaf-spot diseases of the currant also attack the gooseberry. They are discussed on page 424.

MILDEW.

(*Sphaerotheca mors-uvae* (Schw.) B. & C.)

Description.— The mildew usually makes its first appearance on the young shoots and leaves. Here it will first attract the observer's attention as a collection of some bright, frosty substance. On close examination it will be found to be composed of a mass of glistening white threads that spread rapidly under favorable conditions. The more mature portions of the fungus take on a dirty brown color. Later it attacks the fruit in a similar manner. The threads often spread over the berries until they are entirely covered with a mass of brown, felt-like mold, which renders them unsalable.

European varieties, when grown in this country, are particularly susceptible to the attacks of mildew. Many of those varieties produce very large, fine fruit and are so desirable both for home and market that they would be grown to a much greater extent than they now are, were it not for the attacks of this disease.

When setting out a plantation, a site should be chosen where the land is well underdrained and where there is an abundant circulation of air. Branches that droop close to the ground should be pruned back and the ground underneath kept free from grass or weeds, preferably by frequent shallow cultivation, otherwise by mulching.

Treatment.— Spraying should begin early in spring after the buds break and before the first leaves unfold, using one ounce of

potassium sulphide for two gallons of water. This treatment is repeated at intervals of from seven to ten days depending on the amount of rain that comes to wash off the applications. After the fruit is marketed spraying is no longer resorted to, although the mildew may continue through the season on the ends of growing shoots.

SUN SCALD.

The ripening fruit of the gooseberry is liable to sun scald. The skin at first has a bleached appearance and afterwards the fruit shrivels and drops. The conditions which bring about this trouble are not well understood. It sometimes causes serious loss.

Remedy.— The only remedy known at present is to pick the fruit while it is green, *i. e.,* unripe.

GOOSEBERRY INSECTS.

The saw flies which attack the gooseberry are of the same species at those which are found on the currant. See page 426.

GRAPE DISEASES.

The various prominent vineyard diseases of the State, with the exception of the anthracnose, may be controlled by spraying according to directions given for treating the black rot, page 430.

ANTHRACNOSE.

(*Sphaceloma ampelinum* DeBy.)

Description.— This disease attacks any tender portions of the growing vine. When the leaves are affected dark spots are first formed on their surface. As the disease advances these spots enlarge, and irregular cracks are often formed through the dead tissue. Frequently many of these small cracks run together, forming a long irregular slit through the leaf. Similar marks are formed on the tender shoots, though they are not so noticeable. When the fruit is attacked the disease is sometimes called bird's-eye rot. Circular spots are formed on the surface of the berry.

The spots may be of different colors and usually have a dark border; as the spots enlarge and eat in, a seed is often exposed in the center. The berries do not rot, but the tissue becomes hard and wrinkled. Sometimes the disease girdles the stem of a fruit-cluster, cutting off the supply of sap from the grapes beyond the diseased line and causing them to shrivel and die.

Treatment.— Anthracnose does not spread as rapidly as some other vineyard diseases, neither does it yield as readily to treatment. When a vineyard is badly infested with anthracnose, it requires prompt attention and careful treatment to control the disease. It is not satisfactorily controlled by the Bordeaux mixture treatment alone, which is recommended below for black rot and mildew. It is suggested that in addition to such treatment the plan be followed which is advocated by certain European authorities, of applying a warm saturated solution of copperas (iron sulphate) in spring when the buds are swelling, but before they begin to open. One per ct. or more of sulphuric acid may be added to the solution before it is applied. This solution must be handled with care as it is very caustic. It is applied with swabs or if the acid is not used it may be sprayed.[25] It is essential that the work be done thoroughly, covering all the surface of the canes.

Mr. T. H. King, Trumansburg, N. Y., reports that he has been successful in controlling this disease upon the Vergennes, which is very susceptible to the disease, by pulling the loose bark from the vines and spraying thoroughly with Bordeaux mixture in the spring before the buds start and again three or four weeks later.

BLACK ROT.

(*Laestadia bidwellii* (Ell.) V. & R.)

Description.— This disease may usually be found first on the leaves, where it forms circular, bright reddish brown, or pale brown spots on which there appear later little black dots or pim-

[25] Beach, N. Y. Agr. Exp. Sta. Bul. 86: 79. 1896. Lodeman, Spraying of Plants, pp. 45, 152, 294.

ples. Within the black pimples are developed the germs of the fungus which causes the disease. These germs are given forth and washed by rain, or blown by wind, to other leaves or fruit where they grow and form new diseased spots. In the fruit it also forms circular spots and develops black pimples like those formed on the leaves. The diseased fruit withers, turns black, and becomes hard and shriveled, clinging to the stems sometimes till the following spring. The disease may also attack the green shoots.

Treatment.— All diseased fruit shoud be taken from the vineyard, since it is capable of spreading the disease the following spring. Trimmings from the fruit containing diseased berries ought not to be returned to the vineyard in the shape of compost as is sometimes practiced, since the diseased berries are liable to spread the black rot through the vineyard.

This disease may be successfully controlled by thorough spraying if done at the right time. Bordeaux mixture, 1-to-11 formula, is used for this purpose. It is prepared as directed in Bulletin 121. The applications are made as follows:

I. Just as the pink tips of the first leaves appear.

II. From ten days to two weeks after the first spraying.

III. Just after the blossoming.

IV. From ten to fourteen days after the third treatment.

V. If a fifth treatment is necessary let it follow the fourth after an interval of from ten to fourteen days.

VI. If a later treatment than the fifth is needed, ammoniacal solution of copper carbonate should be used; as that it less liable to stain the fruit than the Bordeaux mixture. Directions for preparing it are given below.

The number of the treatments should be governed by the weather conditions and the severity of the disease. If the vineyard is not badly diseased, and if there is not an excessive amount of hot, wet weather, four treatments may be found sufficient for all practical purposes.

The early treatments are extremely important.

Thorough treatment is essential to success.

Paris green or other arsenicals which are recommended against the insects, may be combined with Bordeaux mixture, but not with the ammoniacal solution of copper carbonate.

Ammonical solution of copper carbonate.—The formula usually given for making this solution is as follows: Dissolve five ounces of copper carbonate in three pints of ammonia of 26° strength. When ready to apply, dilute with water so as to make fifty gallons. The undiluted solution may be preserved for some time in tightly closed vessels.

Penny finds[26] that the use of the strong undiluted ammonia in dissolving the copper is wasteful and unsafe. He recommends the following method of making the solution. "To one volume of 26° Beaumé ammonia (the strong ammonia of commerce) add from seven to eight volumes of water. Then add copper carbonate, best in successive quantities, until a large portion remains undissolved. The mixture should be vigorously agitated during the solution and finally allowed to subside, and the clear liquid poured off from the undissolved salt. A second portion should then be made by treating the residue of the former lot with more ammonia diluted as before, then with the addition of fresh copper carbonate, in every case with vigorous stirring or agitation. The method of making in successive lots will result in a richer solution of copper, at least unless an unwarranted length of time be taken." He finds that much less ammonia is required to dissolve a given amount of copper carbonate in this way than according to the method formerly followed of adding the strong, undiluted ammonia directly to the copper carbonate.

CHLOROSIS OR YELLOW LEAF.

The name is applied to a grape disease in which the foliage turns yellow, later becoming brown. It is common in some parts of the State.

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[26] Del. Agr. Exp. Sta. Bul. 22.

Chlorosis is more likely to appear in wet seasons. Some varieties, as the Diamond, are much more susceptible than others. In some seasons portions of the leaves may become yellow, but eventually regain their normal color so that at the close of the season the vine appears to be in a healthy condition. In other instances the yellow color extends over the entire leaf; brown, dead patches appear; the leaf curls and eventually drops from the vine. If the vine loses its leaves two or three seasons in succession it is likely to die. One striking peculiarity of the disease is the fact that a badly diseased vine may appear by the side of a perfectly healthy vine of the same variety.

The cause of chlorosis, as given by foreign investigators, is the presence of a large amount of lime in the soil which prevents the roots from taking up an amount of iron sufficient for satisfactory growth. Their experiments show that the difficulty may be overcome by applying a small amount of sulphate of iron around affected plants. But since there are a number of good American varieties that are not subject to chlorosis, perhaps the better method to pursue is to plant only such varieties as are known to be free from this trouble.

The standard varieties given in the following list are, so far as we know, practically exempt from chlorosis:

Moore Early,	Concord,
Winchell,	Catawba,
Delaware,	Vergennes,
Worden,	Agawam.
Niagara,	

DOWNY MILDEW.

(*Plasmopara viticola* (B. & C.) Berl. & DeT.)

Description.— In some sections of the State the downy mildew causes considerable loss to the grape grower. It may attack nearly every portion of the current season's growth,— leaves, shoots and fruit. Its first appearance on the leaves, that will be

noticed by a casual observer, is in dry, brick red spots on the upper surface. On the under side of the leaf the diseased area will be covered with the interlaced threads of the fungus. The red spots increase in size until in many instances the entire leaf dies and falls to the ground. It frequently causes the berries to turn dull brown and become soft and shriveled. This appearance of it has been commonly called "brown rot." The spores are found on the threads which issue from the under side of the leaves or from the stems or fruit, the whole giving when fresh a glistening white downy appearance from which the disease takes its most common, and preferable name of "downy mildew." Later the parts of the fungus exposed on the surface assume a gray hue and so the disease has also been known as "gray rot." Some varieties, like Delaware, appear to be quite susceptible to the attacks of the disease and none of the cultivated varieties are known to be entirely exempt.

Treatment.— It may be successfully treated in the manner described for black rot. See page 430.

POWDERY MILDEW.

(*Uncinula spiralis* B. & C.)

Description.— Unlike many of our fungous diseases, the powdery mildew flourishes best during the dry weather of mid-summer. It usually begins its attack in June, though it may appear earlier. Its name is descriptive of its appearance, as it forms dull white, powdery patches on the young shoots on the upper surface of the leaves. When the fungus is abundant it seriously checks the growth of the vines by absorbing the nourishment that should have gone to their development. The berries may be attacked at any stage of growth and they are injured or destroyed in the same way as are the shoots or leaves.

Treatment.— It may be successfully treated in the manner described for black rot. See page 430.

GRAPE INSECTS.

CANE BORER.

(*Amphicerus bicaudatus* Say.)

A small cylindrical beetle, which works as a borer in its mature stage. It injures the grape by burrowing into the stems in spring near the base of the new growth. It breeds in the dying wood. The larva sometimes feeds upon the grape vines.

Treatment.— As it breeds in the dying wood, careful cutting away and destroying of such wood will help to check the insect.

GRAPE-VINE FLEA-BEETLE.

(*Haltica chalybea* Ill.)

Description.— The adult insects are shining steel-blue flea-beetles measuring about one-fifth of an inch in length. They live during the winter under the bark of the old vines or in rubbish in the fields. They emerge from their winter quarters during the first warm days of spring, and feed upon the opening buds and young leaves. Egg laying begins late in April or early in May. The eggs are placed singly near the buds or upon the leaves and hatch in about ten days. The young larvæ are dark brown in color but soon become prominently marked with black dots and patches. They are full grown in from three to four weeks at which time they measure about a quarter of an inch in length. They feed on the leaves, devouring only the soft parts at first, but finally eating irregular holes through the leaves. When ready to pupate they go a short distance into the ground. The adults emerge from these pupæ during the latter part of June or early in July. They probably feed during all of the summer, finally seeking shelter for the winter as above indicated.

Treatment.— The vines should be sprayed with Paris green, one pound to fifty gallons of lime and water, just before the buds begin to swell. Much pains should be taken to make this appli-

cation thorough. Later, when the worms appear on the leaves, Paris green may be applied at the usual strength, one pound to 150 gallons of lime and water, or combined with Bordeaux mixture. Both upper and under surfaces of the leaves should be covered.

GRAPE FRUIT WORM.

(*Eudemis botrana* Schiff.)

Description.— The young caterpillars feed within the grapes finally causing them to turn dark colored and to wither. This injury is sometimes mistaken for the black rot. After devouring the soft parts of one grape the caterpillar goes to another, fastening the two together by a silken thread. This may be continued until several in a bunch have been destroyed by one caterpillar. The young caterpillars are very light green in color with a brown head. When full grown they measure about one-fourth of an inch in length and are dark olive green in color tinged slightly with red. The cocoon is formed on a leaf and is partially composed of two small pieces cut out of the leaf. The adults emerge in about ten days. The fore wings have a bluish tinge and are marked with brown, while the posterior wings are dull brown. The moths are small, measuring nearly half an inch from tip to tip when the wings are spread. The eggs are probably laid late in June or early in July. There is probably but one brood annually in this State.

Treatment.—As the caterpillars spend most of their lives within the grape berries, spraying will have little or no effect. There seems to be no better way than picking and destroying the infested fruit and the leaves containing the cocoons.

GRAPE LEAF HOPPER.

(*Typhlocyba vitifex* Fitch.)

There are several species of leaf hoppers which attack the grape, but this species is probably the most common in this State. These

little leaf hoppers are often erroneously called thrips. They jump quickly when disturbed.

Description.— The adult insects measure about one-eighth of an inch in length. They vary greatly in color, but the prevailing color is usually light yellowish green. The back and wings are ornamented with bright red, yellow and brown. They are found upon the vines from spring until fall. They feed together, sucking the sap from the leaves, principally from the under surface, causing them to turn brown in patches. Writers disagree as to the egg-laying habits of this species. The young resemble the adults in form, but are not provided with wings and are green or yellowish green in color. There are several broods during the season. Some of the adults of the last brood hibernate in any convenient rubbish about the vineyard.

Treatment.— The vineyards should be kept free from rubbish. Much good may be done by thoroughly spraying the vines with kerosene emulsion, one part to from seven to ten parts of water, or whale oil soap, one pound to seven gallons of water. This is not entirely satisfactory as many of the leaf hoppers will fly before the insecticide reaches them, but some benefit is derived from the emulsion or soap solution that remains on the leaves as it undoubtedly makes them offensive to the insects.

A practical method of combating this insect is found in what is popularly known as the shield method. The shield consists of a frame with a cloth stretched over it and saturated with kerosene oil, with tar softened until it is very sticky or with some other sticky substance. When ready for use it is carried in a horizontal position between the rows. The vines are agitated at the same time and as the insects fly or jump into the air many of them will come in contact with the sticky surface where they soon die or are wet with kerosene which is fatal to them. This method should be used during the warm part of the day and should be continued every day until the insects are materially lessened in numbers.

GRAPE-VINE SAW FLY.

(*Blennocampa pygmaea.*)

Description.— The larva of this saw fly is a yellowish green slug, with numerous rows of black dots across the body. They feed together principally upon the under sides of the leaves. The life history of this species is similar to that of the currant saw-fly. See page 426. There are two annual broods.

Treatment.— The infested vines should be sprayed with hellebore, one ounce to two gallons of water. If the spraying is not done until the larvæ are half grown or over, use one pound of hellebore to one gallon of water. Much pains should be taken to wet the under surfaces of the leaves. Paris green, one pound to 150 gallons of lime and water, may be used before the grapes are half grown.

PEACH DISEASES.

Caution.— Before discussing the diseases and insect enemies of the peach, attention should be called to the fact that the foliage of stone fruits and especially of the peach is *peculiarly liable to injury* from Paris green, London purple or copper in solution. For this reason the former should not be used stronger than one pound to about three hundred gallons of water and at least two or three times as much freshly slaked lime as poison should be used. It is doubtful whether more than two sprayings with Paris green or London purple should be given even if diluted to the strength just stated. If Bordeaux mixture is used especial care should be taken to have an excess of lime in the mixture.

CROWN GALL OR ROOT KNOT.

Description, etc.— In this disease large knots appear on the roots. The knots are irregular in form, rough on the surface, sofe and spongy within and of various sizes, from the size of a pea to the size of a fist. They may occur on any part of the root system, but are found most commonly at the point where the roots branch off from the trunk; hence the name crown gall.

Occasionally, they occur also on the trunk above ground. In all cases the knots are detrimental to the trees and when they occur at the crown the tree is worthless.

The disease is common in some of the nurseries in the State. The cause of it is wholly unknown. There are indications that it is infectious but this has not been proven.

Similar knots occur on the roots of the raspberry, blackberry, pear, apple, plum, apricot, grape, and a few other woody plants. Among fruit growers it is the popular opinion that the disease is the same on all of these different plants, and that any one of them may communicate the disease to the others. However, this has not yet been demonstrated by carefully conducted experiments.

Treatment.— No remedy is known. Affected trees should never be planted. It is not even safe to plant trees from which the knots have been removed. Avoid planting fruit trees in soil known to be badly infested by the disease.

FRUIT ROT OR RIPE ROT.

(*Monilia fructigena* P.)

The ripe rot of the peach is caused by the same fungus as that which produces the ripe rot of cherry and plum. It is discussed on age 420.

Treatment.— Chester[27] who has given special attention to this subject advocates spraying with Bordeaux mixture just before the blossoms open and again after the fruit sets. Spray with copper acetate (finely powdered, 8 ounces to the barrel), when the fruit is ripening. Copper acetate does not discolor the fruit as Bordeaux mixture does. Observe the caution given above concerning the liability of injuring peach foliage by spraying.

GUMMING.

The formation of gum by the apricot, cherry, peach or plum may follow any injury by cuts or bruises or by the attacks of

[27] Chester, F. D. Ninth Ann. Rept. Del. Agr. Exp. Sta., 1897: 28.

insects or fungi. The young bark of stone fruit trees may be nearly covered with gum pockets as a result of bruises from hail stones. Wounds made in pruning are often followed by a flow of gum. It has been shown by some experiments that where the peach is pruned during the period of greatest vegetative activity, *i. e.,* from April to August, there is a greater production of gum in the wounds than where the pruning is done later[28].

When gumming results from adverse conditions of environment, of from over bearing, excessive pruning or any other cause which severely checks growth, it may often be remedied by making the conditions as favorable for growth as possible, as, for example, by frequent tillage, by the use of stable manure or other fertilizers, by draining the soil, by thinning the fruit to prevent overproduction and by treatment against diseases and injurious insects.[29]

LEAF CURL.

(*Exoascus deformans* (Berk.) Fckl.)

Description.— The name is descriptive of the disease. The disease is caused by a fungus which not only attacks the leaves but may be found in the twigs as well. The curled leaves become distorted, crumpled, enlarged and curled. The disease may often be detected when the leaves first start from the buds in spring. The diseased leaves eventually fall so that in early summer the tree may be almost defoliated. In 1898 the disease caused a loss of many thousands of dollars to the fruit growers of the State by injury to the trees and by the premature dropping of the fruit which followed the loss of the foliage.

Treatment.— It appears to be demonstrated that leaf curl may be largely prevented by spraying with Bordeaux mixture,[30] 1-to-11

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28 Zeit. f. Pflanzenkrankheiten, 6 (1896): 58, 59.

29 For a more complete discussion of this subject, see Beach, S. A. "Gumming of Stone Fruits." Amer. Gard., 19 (1898): 606.

30 Some advise the use of copper sulphate solution, 1-to-15 or 1-to-20 formula, instead of the Bordeaux mixture, but we advocate the latter because it adheres so well.

formula, in spring before the buds begin to open. Some advise later sprayings but as the peach foliage is very susceptible to injury from the use of spraying mixtures including even Bordeaux mixture, we are not prepared at present to outline a satisfactory line of treatment for the foliage.

LITTLE-PEACH DISEASE.

This disease appears to have been first described by Taft[31] in March, 1898. In October of the same year Smith[32] published a more extensive account of it. It seems to have been known to some extent among peach growers for many years.[33] It is considered to be as contagious and as fatal as the yellows.[34] Dr. Smith describes it as a disease in which the peach fruit is from one-half to one-third the diameter of healthy fruit, and it may ripen from one to two weeks later than the healthy fruit. The leaves average, perhaps, one-half normal size and have a sickly color. The larger roots appear to be all right but the ultimate rootlets appear to be diseased. No fungous parasite has as yet been found to be the cause of the trouble. The remedy now advocated is the same as for yellows, viz.: Dig out and burn the diseased trees.

YELLOWS.

The best treatment for peach yellows is to dig out and burn the diseased trees. It has not been found that a healthy tree planted where a diseased tree stood is more apt to have the yellows than if planted elsewhere, other conditions being similar. Among the characteristics of the disease may be mentioned the appearance of clusters of willowy shoots, sickly color of the foliage, premature ripening of the fruit and red colored spots in the flesh of the fruit.

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31 Taft, L. R. Mich. Agr. Exp. Sta. Bul. 155: 303–304.

32 Smith, E. F. Notes on the Michigan disease known as "Little Peach." Fennville (Mich.) Herald. Oct. 15, 1898.

33 Mann, W. T. Proc. W. N. Y. Hort. Soc., 1899: 142.

34 Robinson, F., and Morrill, R. Proc. W. N. Y. Hort. Soc., 1899: 142.

PEACH INSECTS.

BORER.

(*Sannina exitiosa* Say.)

Description.—The adult insects are beautiful moths. The male measures about an inch and the female an inch and a half from tip to tip of the expanded wings. The general color is deep steel blue. The female has a broad band of orange across the abdomen. They appear during May and early June. The eggs are usually deposited on the bark at or near the surface of the ground, although they are sometimes deposited higher up on the trunk and even upon the larger limbs. The eggs are only a few days in hatching and the young larvæ quickly work their way into the sap wood where they feed during the remainder of the season. They remain dormant during the winter in their burrows, form a cocoon and finally issue as moths as above indicated. There is but one brood annually.

Treatment.— As preventive treatment numerous washes have been suggested. In a series of expriements which included a large number of trunk washes Slingerland[85] reports the best success with gas tar. The tar was warmed slightly to facilitate handling and applied to the trunk. It "apparently kept out four-fifths of all the borers, only a small percentage of the trees became infested and no injury resulted to the trees." Professor Slingerland also states that in his experience "the tar did not interfere with the growth of the trees in the least." This treatment should be combined with the digging out method. He also states that in this State the applications of washes, such as gas tar, should be made between June 15 and July 1, and "should remain in perfect working order until October 1." It should be remarked that gas tar is a substance of very variable composition and instances are known where disastrous results to the trees followed its use in the manner which is here described.

[85] Cornell Univ. Agr. Exp. Sta. Bul. 186, pp. 217, 224–225.

Keeping wood ashes about the base of the trees is considered by some extensive growers to be an effective treatment. The surest treatment is to kill the borers every spring and fall with a flexible wire inserted in their burrows or to remove them with a knife.

After the borers are dug out in the spring in May, mound six inches high or more with fine earth, packing it tightly against the base of the tree. This compels the moths to lay their eggs on the bark above the top of the mound. About the first of August carefully examine the trunk by removing a little earth at the top of the mound where the borers, if any, may be easily found. Remove them with the knife. A second search should be made in October and a third one during the following May. If the earth is left at its usual level without mounding, the eggs are deposited so near the roots that the borers can easily work downward to where it will be difficult to find them.

BUD MOTH.

(*Tmetocera ocellana* Schif.)

Sometimes very destructive to the peach. The caterpillars bore into the buds and even into the wood beneath. Treatment same as recommended on page 409.

CURCULIO.

The plum curculio is sometimes a serious pest in the peach orchard. Remedies for this insect are discussed under "Plum curculio" on page 455.

FRUIT-BARK BEETLE.

(*Scolytus rugulosus* Ratz.)

Description.— The adult insects are black, somewhat cylindrical beetles about one-tenth of an inch long and about one-third as broad. They appear early in the spring and bore small round holes through the bark to the sap wood. The eggs are laid beneath the bark and the grubs feed on the sap wood, mak-

ing characteristic galleries. Pupation takes place under the bark, the adults finally gnawing their way out. There are probably several broods in one season. It attacks a variety of fruit trees.

Treatment.— As a preventive measure trees should be kept in a healthy, vigorous condition; as such trees are less liable to attack than weak ones. Trees which become badly infested should be dug up and burned.

PEAR DISEASES.

FIRE BLIGHT.

(*Bacillus amylovorus* (Burr.) De Toni.)

Description, etc.— This disease shows itself in the dying of entire twigs, large branches or even the tree itself. It is a bacterial disease that has long been known but whose real nature was first discovered in 1879 by Dr. Burrill of Illinois. It was afterwards studied very carefully at this Station by Dr. Arthur[36] and more recently by Mr. M. B. Waite [37] of the United States Department of Agriculture.

The disease usually makes its first appearance soon after the blooming period. The young fruit clusters and the twigs bearing them turn black. The leaves also blacken and die but do not fall. If affected twigs are not removed the disease rapidly works its way down into the larger branches.

According to Waite[38] the blight germs do not live over winter in the soil. Moreover, he finds that in the majority of the affected branches even, the germs die soon after the close of the growing season. It is only in a small proportion of the affected branches that the germs survive the winter. Such "hold over" cases, as he calls them, become centers of infection during the following spring. Branches in which the germ is alive do not show a definite line of demarcation between the healthy and diseased

[36] See Annual Reports of this Station, 1884: 357; 1885: 241; 1886: 275.

[37] Waite, M. B. The Cause and Prevention of Pear Blight. Year-Book U. S. Dept. Agr., 1895: 295–300.

[38] Loc. cit.

wood. The infection is spread chiefly by insects, especially by bees.

Pear blight attacks several other pomaceous plants — the apple, crab apple, quince, etc.

Treatment.—Although the cause of the disease is now well known no thoroughly successful method of treating it has been found. The only thing that can be done is to cut out and burn the diseased parts as soon as the blight appears. This should be done promptly; for the disease spreads rapidly. Waite recommends[39] that all trees subject to the disease be thoroughly inspected several times during the growing season. He says that the two most important periods for such inspection are: (1) About two weeks after blooming; (2) just before the leaves drop.

The cutting should be done several inches below the lowest point of discoloration, in order to make sure that all of the disease is removed. Care should be taken never to cut into healthy wood with a knife or saw that has come in contact with diseased wood, until after the tool has been disinfected by wiping it off with a cloth saturated with kerosene, a five per ct. solution of carbolic acid, or some other germicide.

LEAF BLIGHT.

(*Entomosporium maculatum* Lev.)

Description.—This is caused by a parasitic fungus which makes its appearance early in the spring. It is first found on the new leaves where it appears as bright, reddish spots on the upper surface. These spots rapidly increase in size and later the leaves turn brown and finally fall. It attacks the young twigs in the same manner and frequently kills back many of them. When the fruit is attacked the bright colored spots are first formed. These spots soon become dark colored, and spread out in every direction; the surface of the pear becomes rough where attacked by

39 Fifty-Seventh Ann. Rept. N. Y. State Agr. Soc., 1897: 787.

the disease and at these places the growth is checked. Sometimes the fruit becomes cracked as it does when attacked by the scab. This disease appears to be more severe in states south of New York and in regions near the Atlantic coast than it is in the interior of the State, where it causes little damage except as a nursery disease.

Treatment.— The treatment advocated for pear scab is also recommended for this disease when it appears in the orchard.

LEAF SPOT.

(*Septoria piricola* Desm.)

Description.— This disease may be readily distinguished from the one last described if the two are carefully compared. The leaf spot when fully developed has a somewhat angular outline and whitish center in which appear small black specks, the bodies in which the spores of the fungus are borne.

Treatment.— The only experiments in treating this disease which have come to our notice are those by Duggar[40] who advocates similar treatment to that recommended against leaf-blight.

SCAB.

(*Venturia pirina* Aderh.[41])

Description.— This disease is caused by a fungus very similar, both in appearance and in the injury which it does to leaves and fruit, to the apple scab fungus. It robs the leaves of the nourishment which they are preparing for themselves and for the growth of the tree and fruit; it spots the fruit and in very severe attacks causes it to become one sided, distorted or cracked. While it does not kill the trees or branches as the blight may do, still it is believed that no disease, year after year, causes so great loss in pear orchards in New York State as does the scab. Some varieties appear to be comparatively exempt from its attacks while

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[40] Duggar, B. M. Cornell Univ., Agr. Exp. Sta. Bul. 145: 602–604.

[41] This is the ascosporic stage of *Fusicladium pirinum* (Lib.), Fckl.

others suffer quite severely. With varieties which are thus injured by its attacks, it weakens the tree, it lessens the yield, it makes a large part of the fruit unsalable or of an inferior grade, and even the No. 1 fruit sells for less in the market than it would were it free from the blemishes caused by the scab. It is also conceded that fruit free from scab keeps better and is handled easier than the fruit of the same variety blemished with scab spots.

Treatment.— This disease may be controlled by treatment with Bordeaux mixture.[42] Paris green or its equivalent may be used at the same time against the codling moth and leaf eating insects. The general treatment recommended for the scab and other pear diseases is given on page 452.

PEAR INSECTS.

BARK LICE.

See under "Oyster-shell Bark-louse" and "Scurfy Bark-louse."

BLISTER MITE.

(*Phytoptus pyri* Scheuten.)

Description.—The first indications of the presence of this insect in the spring are the small reddish spots on the upper surfaces of the young leaves. These spots indicate where the adult mites that have been hibernating on the twigs burrowed into the leaves to deposit their eggs. These spots finally turn black. The eggs soon hatch and the young mites burrow into the leaf, feeding upon its soft tissues. Toward fall the adults migrate to the twigs to remain all winter. There are probably several broods annually.

Treatment.—The infested trees should be sprayed in the spring a short time before the buds burst, either with kerosene emulsion diluted with seven parts of water or with a solution of whale-oil soap, one pound to seven gallons of water. One thorough application has been found to be sufficient. Pruning closely in winter and burning the twigs will also aid in checking the insect.

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[42] Beach, S. A. Bulletin 84 of this Station.

BORER.

See "Sinuate Pear Borer."

BUD MOTH.

The eye-spotted bud moth which attacks pears, is the same as that which infests apple trees. It is also known as the bud worm. Treatment for it is given under apples. See page 409.

CASE BEARERS.

PISTOL-CASE-BEARER. CIGAR-CASE-BEARER.

These insects also infest apple trees and have been discussed under apples. See page 409.

CODLING MOTH.

This insect which causes so much loss to apple growers by causing wormy apples, also attacks pears. It may be treated as recommended on page 412.

LEAF BLISTER MITE.

See "Blister Mite."

PEAR MIDGE.

(*Diplosis pyrivora* Riley.)

Description.—The first indication of injury by this insect is the stunted and dwarfed fruits. If one of these fruits is cut open the maggots will be found near the core. The adult insect is a small two-winged fly somewhat resembling a diminutive mosquito. According to Prof. J. B. Smith[43] it appears early in the season before the buds of the pear blossoms open. The eggs are probably laid in the blossoms and hatch within a few days. The young maggots bore into the embryo fruit, where they remain feeding near the core until full grown. When ready to pupate they leave the fruit and go into the ground to a depth of from one-half an inch to two inches. After remaining unchanged for a time they make

[43] N. J. Agr. Exp. Sta. Bul. 99, page 5.

"oval cocoons of silk covered with grains of sand" (Smith.) This probably takes place any time from early spring to mid-summer, depending upon the locality, although in this State most of them go into the ground in June. They remain as pupæ in the ground all winter, emerging as adults in the spring. Lawrence pears are especially liable to attack.

Treatment.— This insect has proved a very difficult one to control. Experiments have been made with a view to destroying the pupæ in the ground, but it has been found that in order to successfully check the insect a dangerous amount of the insecticides tested must be applied to the soil. Hand picking, where practical, is probably the most satisfactory method of checking the insect. It should be done in June.

OYSTER-SHELL BARK-LOUSE.

This insect also has been discussed under apples, page 417. It is sometimes very injurious to young pear trees.

PEAR PSYLLA.

(*Psylla pyricola* Forst.)

Description.— This insect causes injury in two ways. First, by sucking the sap; second, by disfiguring trees and fruit. Its presence is usually betrayed by the honey dew secreted by the young, wingless forms. The honey dew afterwards becomes covered with a black mold giving the leaves and twigs a black unsightly appearance.

The adult is an active four-winged insect measuring about one-tenth of an inch in length. It has been compared to a miniature seventeen year locust. A number of broods are produced during the summer, and the adults which live through the winter are distinct in form from the summer adults. They appear early in the spring and deposit their eggs in protected places on the bark. The eggs hatch within a few days and the little larvæ, or nymphs, at once commence to suck the juices from the young leaves and

twigs. Where the nymphs are numerous they take so much nourishment from the trees that the new growth is seriously checked. The whole tree assumes a stunted, unhealthy appearance. As a natural result the fruit crop is greatly lessened and, in some instances, trees have been killed. The first brood in the spring probably does the most direct injury. A favorite place for the young nymphs is in the axils of the leaves and at the base of the fruit stems. Within two or three days after hatching they cover themselves with honey dew which finally becomes so abundant as to disfigure the leaves and fruits, the amount of injury done in this way varying of course with the number of nymphs.

Treatment.— The young nymphs are most easily reached. Close watch for them should be kept when the leaves are unfolding in the spring. As soon as the nymphs are found spray the trees thoroughly with kerosene emulsion diluted with about ten parts of water[44] or with a solution of whale-oil soap, one pound to from five to seven gallons of water. Two applications about ten days apart will probably be necessary. It is important to begin the work before the nymphs have covered themselves with honey dew as it is then much more difficult to reach them with a spray.

SAN JOSE SCALE.

(*Aspidiotus perniciosus* Comst.)

Description.[45]— This insect may be briefly described as a small, nearly circular, ash-gray scale with a prominent dark nipple at the center. These are the female scales. They are always greatly in excess of the males and are chiefly responsible for the injury which is done. The San Jose scale attacks the bark, leaves and fruit. In common with certain other scale insects it causes a

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44 Some growers use a much stronger emulsion than this with apparently no injury to the trees.

45 This insect is discussed more in detail in Bulletin 136 of this Station, pages 587–593, by V. H. Lowe.

crimson discoloration of the sapwood and fruit. It multiplies with great rapidity. In examining a tree for this insect the trunk and larger limbs and the fruit should receive an especially close scrutiny as the scales are often found here in large numbers when only scattering on the smaller limbs.

Treatment.—The treatment of this insect is a matter of so great importance that it will be made the subject of a separate bulletin. Where it has once become firmly established it probably cannot be exterminated. When recently introduced it has in some cases been exterminated by burning the infested trees, or by thorough treatment with whale-oil soap at the rate of two pounds to a gallon of water, or by both. The most effective known method of treatment is fumigation with hydrocyanic acid gas. The use of kerosene and water or crude petroleum is still in the experimental stage and cannot as yet be recommended for general use.

SCURFY BARK-LOUSE.

(*Chionapsis furfurus* Fitch.)

Description.— This insect sometimes occurs in large numbers upon young pear trees. The scales are a dirty white color, broadly wedge shape in outline and vary in length from about one-sixteenth to nearly one-eighth of an inch.

The life history of this species is very similar to that of the oyster-shell bark-louse; with both species the eggs are retained under the parent scale during the winter. The eggs vary greatly in number, from ten or twelve upwards, as many as seventy-five having been found under a single female scale. They hatch from the first to the middle of May. There is probably but one brood annually. The male scale is much smaller than the female, is elongate, with nearly parallel sides and is a clearer white color. The adult male is a delicate two winged insect.

Treatment.— The treatment for this insect is the same as for the oyster-shell bark-louse. See page 417.

SINUATE PEAR BORER.

(*Agrilus sinuatus* Oliv.)

Description.— This insect was recently introduced into this country from Europe. It has become seriously injurious in some parts of the eastern United States. It makes long zig-zag galleries between the bark and wood, finally girdling and killing the tree. It is said to live two years in the larval stage. The larva is slender, and has the first segment back of the head much enlarged. The adult is a small, slender beetle. The eggs are laid on the bark of the tree.

Treatment.—When a tree becomes infested it is very difficult to get the borers out, and it is usually impractical to attempt to do so. As preventive measures some good may be done by placing mechanical obstructions on the trunks, such as tarred paper wound about the trunk, or wire netting; the object being to prevent the adult from depositing eggs in the bark. Whitewashing the trunk with ordinary whitewash to which enough Paris green has been added to tinge it slightly, or with a strong soap wash, one pound of whale oil soap to one gallon of water, has been recommended. The trunks should be kept covered with one of these washes during May and June.

PEAR SLUG.

(*Selandria cerasi* Peck.)

Description.— The adult insect is a small, dark-colored, four-winged fly. The slugs make their appearance in the latter part of May or early June. At first light in color they soon become darker and are covered with an abundance of slime. The slugs feed on the upper surface, skeletonizing the leaves, and where very abundant they cause serious injury. Leaves that are badly injured wither and fall.

Treatment.— If upon examination it is found that the insects are likely to appear in sufficient numbers to cause much damage, no time should be lost in spraying the trees with Paris green. If the trees are being treated for fungous diseases the Paris green

should be combined with the Bordeaux mixture. A second brood of this insect usually appears in August. The only thing to be done is to spray when the indications are that the slugs are numerous enough to be injurious. On low trees they are sometimes treated with air-slaked lime or road dust, by throwing the dust or lime over the trees.

GENERAL TREATMENT AGAINST DISEASES AND INSECTS WHICH ATTACK THE PEAR.

When to spray.	What to use and what the treatment is for
1. Just before blossoms open.	Bordeaux mixture[46] against the scab, leaf blight, leaf spot and canker disease.
2. Just after blossoms fall.	Bordeaux mixture[46] against the scab, leaf blight, leaf spot, etc.
	Paris green[47] against codling moth and leaf-eating insects generally.
3. From ten to fourteen days after 2.	Bordeaux mixture[46] against the scab, leaf spot, leaf blight, etc.
	Paris green[47] against codling moth and leaf-eating insects generally.

For treatment of fire blight, bud moth, case bearers, etc., consult the special notice of these subjects on previous pages.

PLUM DISEASES.

BLACK KNOT.

(*Plowrightia morbosa* (Schw.) Sacc.)

Description.— This disease causes swellings underneath the bark, finally rupturing it and developing a spongy texture covered

[46] Use Bordeaux mixture, 1-to-11 formula. Directions for making and applying are given in Bulletin 121. The Paris green or other arsenicals may be mixed with the Bordeaux mixture if desirable to apply both at one time.

[47] Use Paris green at the rate of 1 pound to 150 gallons of water, with about two pounds of fresh slaked lime added to make it adhere, and to prevent injury to foliage. Green arsenite of copper, arsenite of lime, or other poisons may be used instead of Paris green, as directed in Bulletin 121. These arsenicals may be mixed with Bordeaux mixture instead of water, at the same rate as given above. In that case, not much extra lime need be added.

with dark olive-green mold. In this stage the summer spores are produced which spread the infection to other trees.

Late in the season the knot becomes hard with a black surface, which finally becomes covered with fine black pimples inside of which are matured the winter spores. The winter spores escape late in winter or early in spring and serve to spread the disease. A more extended discussion of this disease is given in Bulletin 40 of this Station, and in the Annual Report for 1893, page 686.

Treatment.— The best known remedy for this trouble is to cut out and burn the knots. They can be found most readily after the leaves have dropped in the fall. They should then all be removed before mid-winter so as to be sure of destroying them before the spores mature and escape. Early in the summer the new knots should be watched for and promptly removed and destroyed. The infection frequently comes from the knots on neglected plum or cherry trees along fence rows or in neighboring orchards. In removing the knots the branch should be cut off three or four inches or more below where the knot appears, so as to remove the threads of the fungus that may extend down the branch to a considerable distance from the knot. The same disease also affects various wild plums and wild and cultivated cherries. It is rarely found on sweet cherries but sometimes is very destructive to the Morello class.

FRUIT ROT.

(*Monilia fructigena* P.)

The ripe rot or fruit rot of the plum is caused by the same fungus as that which causes the rot of the cherry fruit.

Treatment.— The treatment advocated for the leaf-spot will hold this disease in check somewhat. The spraying of the ripe fruit presents the same difficulties as it does with the cherry. See page 420.

When there is reason to fear that the disease will attack the blossoms, treatment with Bordeaux mixture should be made just before the blossoms open. Thinning the fruit is no doubt a par-

tial preventive, because when the rot attacks one of a cluster of fruits it usually spreads till every fruit in the cluster is diseased. When the fruits do not touch each other the disease is less destructive.

LEAF SPOT.

(*Cylindrosporium padi* Karst.)

This disease is discussed under leaf spot of the cherry. See page 421. In general it is more liable to produce the shot hole appearance on plum foliage than on cherry foliage.

Treatment.—As a result of extended experiments it can be stated that the plum leaf spot may be controlled by thorough treatment with Bordeaux mixture, 1-to-11 formula. In some seasons two treatments are most economical, but under conditions favorable to the disease at least three should be given.[48] If but two treatments be made give the first about ten days after the blossoms fall, but not later than June 1; make the second treatment about three weeks later. The disease may be better controlled by three treatments and usually three treatments will be most profitable. Make the third from three to four weeks after the second.

YELLOWS.

The Japanese plums are subject to a disease which has the appearance of peach yellows. It occurs on trees which have been worked on plum roots as well as on those which are on peach roots. No remedy is known.

The treatment recommended is the same as that which is recommended for peach yellows — dig out and burn the diseased trees.

PLUM INSECTS.

PLUM CURCULIO.

(*Conotrachelus nenuphar* Herbst.)

Description.— The adult is a small, peculiar, gray beetle. It passes the winter under the bark of trees, or under rubbish, and

[48] Beach, S. A. Sixteenth Ann. Rept. this Station, 1897: 211.

comes forth early in the spring to deposit its eggs in the young fruits, commencing as soon as they are formed. It does this by puncturing the tissue and inserting the egg. After the egg is deposited, the beetle cuts a crescent-shaped groove around one side of the puncture evidently to prevent the growing tissue from crushing the egg. The eggs hatch in a few days when the little worm, or larva, at once commences to feed on the fruit causing much of the infested fruit to fall while still young and that which remains on the trees ripen prematurely and soon decay.

The curculio does not confine its attacks to plums, but it usually infests plum orchards and if left unmolested, often destroys an entire crop.

Treatment.— It has been found that the beetles' manner of protection is to fall to the ground when disturbed. Here they curl up so as to resemble bits of bark. Advantage is taken of this habit in fighting the insect by a process known as jarring. The trees are jarred by three or four strokes with a padded crutch or mallet and the insects are caught on sheets spread underneath the tree and destroyed.

The curculio catcher commonly used in the vicinity of Geneva is one made by Mr. J. B. Johnson, Geneva, N. Y. The frame over which the sheet is stretched is attached to a two-wheeled cart. The sheet slopes downwards to the center where an opening allows the bugs to be swept into a tin box underneath the sheet and between the wheels. A slit at one side allows the cart to be run directly under the tree and two or three jars bring down the bugs which are swept into the box above mentioned, by means of a short handled broom. The cultivated ground is made smooth by rolling to prepare it so that the cart wheels will pass over it readily. Jarring should be begun as soon as the fruit sets and be continued as long as the curculio are found in sufficient numbers to pay for jarring, which is usually for about three weeks. Early morning is the best time to do this work. Towards the middle of the day, especially on bright days, they are more active and apt to fly.

The beetle feeds on the plum leaves and for this reason spraying the trees with Paris green or London purple has been advocated. No doubt the insects may be killed to some extent in this way but the foliage of stone fruit trees is particularly liable to injury from Paris green or London purple so that these poisons must be used sparingly and much diluted. When the insect is abundant the jaring is undoubtedly the best way of controlling the pest.

GREEN FRUIT-WORMS.

The green fruit worms sometimes are so abundant on the plum as to cause much damage. The treatment recommended is given on page 413.

PLANT LICE.

Several species of plant lice attack the plum. They collect in great numbers on the under sides of the leaves, causing them to curl and finally drop off. The infested trees should be sprayed with whale-oil soap, one pound to seven gallons of water, as soon as the lice appear. The spraying should be directed from the under side so as to reach all of the lice.

QUINCE DISEASES

CANKER OF TREE. BLACK ROT OF FRUIT.

The canker of the tree and black rot of the fruit of the quince are caused by the fungus which causes similar trouble with the apple and pear. For a discussion of the disease and remedial measures see page 399.

BLIGHT. (FIRE BLIGHT.)

This disease is caused by the same parasite which produces the fire blight of the pear. It is discussed on page 443.

LEAF BLIGHT AND FRUIT SPOT.

(*Entomosporium maculatum* Lev.)

Description.— Fruit spot and leaf blight of the quince are caused by the same fungus that causes pear leaf blight. When a

fruit is attacked, numerous small black specks appear on its surface. As the spots increase in size they often grow into each other and form a large, dark, diseased area. The disease does not extend so deep into the tissue of the fruit as to make it entirely worthless, but the market value is greatly lessened. When the fruit is attacked before it has reached its full size, it often occurs that the quinces, like the diseased pears, are mishapen and undersized. Greater damage is done to the trees when the leaves are severely attacked. The loss of foliage in midsummer not only leaves the fruit undeveloped but it is a severe check to the growth and vigor of the tree.

Treatment.— Favorable results in treating this disease with the Bordeaux mixture are reported. It is suggested that the treatment recommended for apple scab be used against quince fruit spot and leaf blight, making the first spraying when the blossom buds have appeared, the second just as the blossoms are falling, and a third about two weeks later.

RUST.

(*Gymnosporangium* spp.)

Description.— The rust is due to a fungus which becomes established and develops within the tissues of the quince branches or fruit. It causes knotty branches and peculiarly distorted fruit on which there appear tiny fringed pits filed with orange colored dust giving the diseased parts quite a brilliant appearance.

In a different form this rust fungus attacks the red cedar and the common juniper, forming galls on their branches. In these galls are developed spores which, distributed by the winds to quinces, juneberries, hawthorns and apples, become established on these trees and cause the rust. Usually the rust is not abundant enough on quinces to cause serious injury. It is usually recommended that the cedar and juniper trees in the vicinity be destroyed to prevent the breeding of the fungus on them and that the rusted fruit or branches also be removed and destroyed. The

former recommendation is not always practical, and whether the latter course will do any good has not been definitely determined.

QUINCE INSECTS.

BORER.

These are the same as those described under apple insects, page 406. The trunks of the trees should be examined carefully in spring and fall and the borers dug out. Various other remedies have been advocated, but apparently none of them take the place of systematically removing the grubs.

CODLING MOTH.

(*Carpocapsa pomonella* Linn.)

This insect is the same as that which causes wormy apples and pears as described on page 412. It should be treated by spraying with Paris green or some other arsenical poison as soon as the fruit sets, followed by one or two later applications at intervals of ten days, or even less if heavy rains fall in the meantime. The poison thus used is also recommended for the curculio mentioned below. It may be combined with Bordeaux mixture when that is used against fruit spot and leaf blight, using one pound for one hundred and fifty gallons.

CURCULIO.

(*Conotrachelus crataegi* Walsh.)

Description.— The adult insect is somewhat larger than the plum curculio. It is broader just back of the thorax and is a brownish gray color mottled with white. Its life history as worked out by Slingerland[49] is substantially as follows: The winter is passed in the grub stage in an earthen cell two or three inches below the surface of the ground. Here the transformation to the pupa takes place in the spring. The time when the adults

49 Cornell Univ. Agr. Exp. Sta. Bul. 148.

emerge varies with the weather conditions. They may appear any time from late in May until late in July. The adults feed on the young quince fruits and possibly on the leaves. The eggs are laid in "little pits" made by the female beetles in the fruit. The eggs hatch in a few days and the grubs feed in the fleshy part of the fruit until full grown when they go into the ground to pass the winter. There is but one brood annually.

Treatment.— As with the plum curculio, jarring is considered the most satisfactory method of combating this insect. The trees are jarred in the same manner as plum trees for the plum curculio. The "curculio catcher" is mounted on low wheels so that it can be used under the quince trees. As the time when the curculios appear varies, probably with the season, no definite time for beginning the work of jarring can be given. The trees should be watched after the last week of May. The presence of the curculios will be easily ascertained by a few trials at jarring. If they are found the jarring should be continued as long as they are numerous.

RASPBERRY DISEASES.

ANTHRACNOSE.

(*Gloeosporium venetum* Speg.)

Description.— This disease ordinarily makes its first appearance on the young canes when they are less than a foot high. Its presence may be detected by the appearance of small dark or purple colored spots, which rapidly increase in size and change from the dark color to the brown or dirty white in the center as the fungus feeds outward in all directions leaving the dead tissues behind. The slightly raised outlines of the spots vary in color from dark brown to bright purple. In severe attacks the spots are so numerous that they soon coalesce and form continuous blotches that may nearly or completely girdle the cane. The effect on the cane is practically the same as if so much bark had been removed with a knife. While anthracnose is preëminently

a disease of the canes it may occur on any part of the plant above ground. It is most destructive to black raspberries, but also attacks purple raspberries and blackberries and perhaps still other species of *Rubus*. Red raspberries appear to be exempt.

Treatment.[50]— Since, in most instances, a raspberry plantation reaches its limit of profitable production when three or four years old it seems that a rotation of crops, combined with sanitary measures, is the surest method of preventing loss from this disease. As the disease lives over winter in the canes, the old canes, together with the badly diseased new ones, should be removed as soon as the fruiting season is over.

Experiments have shown that the disease may be checked by spraying with Bordeaux mixture, beginning when the new canes are about six inches high and keeping them well protected with the mixture until the fruit is two-thirds grown. Ordinarily, however, spraying for anthracnose is not likely to pay.

RUST.

(*Puccinia peckiana* Howe. Syn. *Caeoma nitens* Schw.)

Description, etc.— This disease is often called the orange rust on account of the orange color of the spores which are produced in dense masses on the underside of the rusted leaves. Sometimes the spore masses occur also on the canes. The fungus attacks blackberries, dewberries and raspberries. It is quite common on wild plants and where these are growing in the vicinity of cultivated varieties the diseased plants among them should be destroyed to prevent them from becoming a source of infection.

Treatment.— Clinton[51] states that the fungus enters the very young underground shoots and growing up through the canes finally appears in the leaves. Since the fungus grows within the canes and infection appears to take place at the root, the only

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50 Paddock, W. The Anthracnose of Black Raspberry. N. Y. Agr. Exp. Sta. Bul. 124.

51 Clinton, G. P. Orange Rust of Raspberry and Blackberry. Ill. Agr. Exp. Sta. Bul. 29.

preventive treatment which can be recommended is digging out and burning the infested plants immediately upon the first appearance of the disease. This treatment will materially check the disease. Affected plants may usually be detected before the rust breaks out on the leaves. The diseased leaves have a pale orange tinge and present a sickly appearance which one soon comes to recognize as characteristic of rust-infested plants. Diseased canes are also apt to be much freer from prickles than are healthy canes.

LEAF-SPOT.

(*Septoria rubi* Westd.)

A leaf-spot of raspberries is caused by the same *Septoria* which attacks blackberries. It is discussed on page 419.

The disease seems to be less troublesome on raspberries than it is on blackberries.

ROOT KNOT.

The roots of raspberries are often covered with galls which are similar to those found on peach roots (see page 437) and are probably due to the same cause. Our knowledge of these root galls is imperfect. To both raspberry and the peach they are very injurious. There is some reason for believing that the disease may be communicated from the peach to the raspberry and *vice versa*. Hence it is advisable to avoid planting peaches on soil in which raspberries have knotted badly. Neither should raspberries be planted where peaches have been affected with the root knot.

RASPBERRY INSECTS.

CANE MAGGOT.

(*Phorbia* sp.)

Description.— This insect works only in the new shoots causing them to wilt and finally die. This wilting of the shoots is first noticeable in May. The adults first appear in spring toward the

latter part of April. The eggs are laid near the tips of the new growth. They hatch within a few days. The little white maggots which emerge from them burrow into the pith of the shoot. According to Slingerland[52] they burrow downward in the pith until they have reached about half the length of the canes when they work nearly out to the bark and each makes a tunnel around the shoot, thus girdling it from the inside. They continue feeding on the pith at the point where the girdling was done, almost severing the shoots. After doing this injury the maggots proceed to murrow downward in the pith, finally reaching the base of the shoots where they transform to the pupa stage. This point in their development is probably reached some time in June. They remain in this condition until the following April.

Treatment.— As the insects work inside the shoots they cannot be reached with a spray. Undoubtedly the most practical method of treatment consists in cutting off the wilted shoots several inches below the wilted portion.

SAW FLY.

(*Monophadnoides rubi* Harr.)

Description.— The adult insects are about the size of a housefly. They appear in the spring and are most abundant in May. The eggs are laid from the under side of the leaf within the leaf tissue. They are usually placed along the midrib and larger veins. The tissue above the eggs turns a light brown in color, causing the infested leaves to become spotted. The eggs hatch in about a week. The young larvæ are light green in color and are well covered with spine-bearing tubercles. They feed at first on the softer tissues, but finally the entire leaf with the exception of the midrib and larger veins is devoured. They also have been known to feed on the tender bark of the new growth and to do some injury to the flowers and fruit. Toward the latter part of June they go into the ground near the bushes upon which they have been feed-

[52] Cornell Univ. Agr. Exp. Sta. Bul. 126, p. 58.

ing, to a depth of two or three inches, where the cocoons are spun in which the transformation to the pupa stage slowly takes place. The transformation is not completed until the following spring. There is but one brood annually.

Treatment.— If the leaves become spotted as above indicated, they should be examined, and if indications of the eggs or larvæ are found they should be sprayed with hellebore, one ounce to the gallon of water, as soon as the young larvæ are numerous. Both the upper and under surfaces of the leaves should be covered. Where only a few bushes are infested the insect may be easily checked by brushing the larvæ onto the ground about the bushes. If the ground is soft and loose most of the larvæ will be unable to return.

STRAWBERRY DISEASES.

LEAF-SPOT.

(*Sphaerella fragariae* (Tul.) Sacc.)

This disease is also called strawberry "rust" or "leaf-blight." It frequently causes much damage by injuring the foliage so that the plants are incapable of perfecting a full crop of fruit, even though a full crop has set, or as Thaxter states, it also attacks the fruit stems and hulls, "cutting off the supply of nourishment from the berries and disfiguring them by the withering of the calyx."

When the spots first appear on the leaves they are of a deep purple color, but later they enlarge and the center becomes gray or nearly white. Portions of the infested leaves frequently assume bright red tints, and when badly diseased finally wither and die.

Treatment.— Bordeaux mixture, 1-to-11 formula, used as advocated by Hunn in the Annual Report of this Station for 1892, p. 682, gives beneficial results. When setting a new plantation be particular to remove the diseased leaves before taking the plants to the field, or if the plants must be trimmed in the field, the diseased leaves should not be left where they can communicate the disease to the new foliage as it grows out. The following treatment is then suggested:

Spray the newly set plants soon after growth begins and follow with three or four treatments during the season, as seems necessary. The following spring, spray just before blossoming and again in from ten days to two weeks. As soon as the fruit is gathered it is generally a good plan to mow off the foliage if badly diseased and burn it if the beds are to be fruited a second season. Should drought follow, the plants may not recover from this treatment sufficiently to give a satisfactory crop the following year.

Varieties differ greatly in their susceptibility to leaf spot. Consequently, one of the best ways to avoid loss from this disease is to plant those varieties which are least subject to it.

STRAWBERRY INSECTS.

CROWN BORER.

(*Tyloderma fragariae* Riley.)

Description.— The adult insect is a dark brown beetle, of the curculio group, measuring about one-sixteenth of an inch in length. The beetles appear in June or July. The eggs are laid on the plant above ground not far from the crown of the root. The eggs hatch into small, white, legless grubs. These grubs burrow down into the crown where they feed until full grown. Pupation takes place within the excavation, the beetles finally escaping about the middle of August. They are unable to fly. There is but one brood annually.

Treatment.— The crown borer is most injurious on old beds, and as each plant that becomes infected is eventually doomed, it will usually be most practical to dig up and burn the infested vines.

GRUBS.

The larvæ or grubs of the common May beetle and other closely related species, frequently do much injury by feeding on the roots of strawberry plants.

The beetles lay their eggs in sod ground. The eggs hatch into white grubs, which feed on the roots of various plants until the

third year, when they pupate, finally coming from the ground as beetles.

Since the grubs live in the ground until the third year after the eggs were laid, it is good practice not to use land for strawberries before the third or fourth year after it was in sod.

SAW FLY.

(*Emphytus maculatus* Nort.)

This insect is only occasionally injurious in this State. The adult insect is a four-winged fly of the general habits of the currant and raspberry saw flies. The larvæ feed upon the leaves. There are probably two broods annually, the second brood passing the winter in the ground.

The larvæ may be killed by spraying the infested plants with hellebore, one ounce to the gallon of water.

METEOROLOGICAL RECORD

FOR

1899.

PRECIPITATION BY MONTHS SINCE 1882.

YEARS.	January.	February.	March.	April.	May.	June.	July.	August.	September	October.	November.	December.	Total.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
1882	....	....	....	....	......	3.69	2.42	2.87	1.25	0.62	1.22	0.55	.....
1883	0.48	1.44	0.68	1.58	4.45	4.12	2.98	3.47	2.12	2.10	1.54	0.73	25.89
1884	1.83	2.01	2.54	0.88	2.49	2.01	2.33	1.44	3.17	1.67	1.01	0.97	22.30
1885	1.07	0.61	0.12	1.26	1.53	2.49	4.64	5.02	2.11	2.83	1.36	0.76	23.90
1886	1.13	0.95	1.13	4.18	1.92	2.92	4.41	2.86	2.31	1.39	3.48	1.24	27.87
1887	0.18	2.17	0.48	1.37	0.46	2.01	6.37	3.08	0.75	1.74	1.58	1.35	22.29
1888	0.78	1.04	1.43	3.09	2.79	3.88	0.99+	4.02	2.73	3.47	2.02	1.24+	27.48
1889	2.99+	0.25	0.66+	3.28	1.21	7.47	4.57	1.98	2.50	3.32	3.44	1.62	32.28
1890	2.16	1.45	2.16	2.20	5.49	5.26	1.07	4.34	5.81	4.54	2.40	..	36.83
1891	1.44	1.57	3.25	1.63	0.49	4.31	3.52	3.16	0.47	3.65	0.74	3.29	27.53
1892	0.57	0.88	0.55	0.67	4.04	3.95	1.89	4.77	1.12	1.84	2.67	0.72	28.17
1893	1.62	3.71	1.94	2.59	4.92	3.06	3.68	5.38	2.68	1.59	1.09	1.56	33.84
1894	2.21	2.71	1.36	2.48	7.13	1.77	1.50	1.22	4.64	3.59	0.43	0.47	29.36
1895	0.96	0.00	0.29	1.33	2.58	......	......	2.66	0.94	0.72	2.31	2.49	.....
1896	1.19	2.28	0.84	0.41	2.31	3.71	4.12	3.33	4.27	2.26	2.18	0.71	27.61
1897	0.64	0.21	2.12	1.90	2.19	3.16	5.23	1.27	2.36	0.73	2.53	1.39	28.78
1898	1.74	0.33	1.54	2.08	1.90	2.39	1.32	3.60	1.66	3.83	2.08	0.33	22.90
1899	0.87	0.30	1.22	1.12	1.69	1.71	4.15	1.05	2.23	2.69	1.36	1.46	19.85

WIND RECORD FOR 1899.

DATE.	January. Northerly, N. W. to N. E.	January. Easterly, N. E. to S. E.	January. Southerly, S. E. to S. W.	January. Westerly, S. W. to N. W.	February. Northerly, N. W. to N. E.	February. Easterly, N. E. to S. E.	February. Southerly, S. E. to S. W.	February. Westerly, S. W. to N. W.	March. Northerly, N. W. to N. E.	March. Easterly, N. E. to S. E.	March. Southerly, S. E. to S. W.	March. Westerly, S. W. to N. W.	April. Northerly, N. W. to N. E.	April. Easterly, N. E. to S. E.	April. Southerly, S. E. to S. W.	April. Westerly, S. W. to N. W.
1	8			21				18	1			18				24
2			13	2		1	2	2	1	7						18
3			23	1		1		1		5	9					24
4			24		6			15		10	14		6			14
5				24				9		6	6	12	6			12
6	4	8		8	2			10		6		12	1	4	3	8
7				24					14	2		4		10	11	
8			8	8				15				22				19
9	7	1		4				24		4	3	6				23
10				6				24		13		3	3			15
11								21			24		1	6	11	
12		6	12					4			14	10		2	10	12
13			24		5			14	2			18	3	5	1	14
14			16	8				18	1	12		2			11	9
15				16			20			4	17	3				15
16			11				14					24				14
17				19			2		2	9		3				14
18	15			1				8		6	15	1		2	11	
19				4				17				15			12	3
20			16				2	23				24	5			4
21			15	8			5	1		9	6	6	8			3
22				24			4	16		4	20				13	
23		8	12	1	7			17			6	18	8			7
24	8		8	9	8			11				24		5		
25				19	8	7		7		12	3	1	5	1	3	1
26			19	5		4	20		5	2		10	6			5
27				19			3	21		1	2		1	8	6	
28			12	2			14	5		1	17				24	
29				15								21			24	
30				18								12			18	4
31				15					5			9				
Total hours of movement	33	18	213	276	31	13	86	300	31	113	156	291	53	43	153	256
Per cent of time in each direction	5.9	3.3	39.5	51.3	7.2	3.0	20.0	69.8	5.8	19.5	26.8	48.4	10.4	8.4	31.0	50.2

WIND RECORD — (*Continued*).

DATE.	MAY.				JUNE.				JULY.				AUGUST.			
	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
1	1	....	15	4	....	....	....	12	....	....	....	18	1	4	1	3
2	6	....	7	11	....	....	....	15	2	....	....	11	1	1	11	3
3	19	....	....	4	2	....	1	10	1	3	8	4	6	....	....	11
4	3	5	3	4	....	7	2	2	....	2	6	1	5	....	....	5
5	2	3	9	6	1	....	....	13	....	....	15	2	8	....	....	11
6	....	2	1	4	....	....	4	14	....	....	....	13	9	....	....	15
7	7	....	....	9	....	....	....	14	3	....	3	3	15	....	....	5
8	6	....	2	4	....	....	....	22	....	....	3	7	....	....	....	24
9	11	....	....	8	....	....	1	17	2	....	....	15	1	12	2	2
10	....	6	5	3	8	....	....	12	....	....	....	18	1	14	1	....
11	1	4	6	13	....	7	10	....	....	1	3	6	1	2	1	....
12	2	....	....	7		....	22	....	4	....	4	6	....	3	21	....
13	....	....	11	12	....	2	9	7	3	....		8	....	....	1	20
14	....	....	....	23	....	....		11	1	....	....	13	7	3	....	1
15	....	....	....	19	....	....	....	9	....	....	5	2	....	10	....	....
16	3	9	3	2	....	....	....	15	....	....	....	11	1	6	4	....
17	6	7	2	2	5	....	....	12	2	....	....	16	1	7	1	....
18	....	....	12	9	....	1	2	8	....	....	....	24	....	7	7	....
19	....	....	....	24	4	....	....	5	3	....	....	15	4	2	2	5
20	2	....	....	22	4	....	....	11	....	....	....	....	8	....	....	....
21	....	....	....	19	3	....	....	17	1	....	....	9	....	1	4	5
22	9	4	....	7	....	10	3	....	5	....	....	....	....	....	....	21
23	6	2	....	2	....	....	10	9	....	....	....	....	....	....	....	13
24	1	5	3	....	5	....	....	7	....	....	13	....	1	2	....	12
25	....	3	7	....	5	....	4	6	....	....	22	....	6	....	2	4
26	....	....	5	1	10	....	....	5	....	....	2	10	1	8	....	2
27	....	....	2	13	1	....	....	18	....	....	....	13	....	11	7	....
28	10	....	....	1	*	....		.	5	1	....	3	....	10	....	....
29	....	8	11	1	2	....	....	14	2	....	4	11	....	6	12	....
30	....	....	..	21	9	....	....	9	....	....	....	22	....	....	14	3
31	....	....	4	8		....	....	....	7	....	....	13		....	7	2
Total hours of movement	95	58	108	263	59	27	68	294	41	7	88	274	77	109	98	167
Per cent of time in each direction	18.2	11.1	10.8	50.4	13.2	6.0	15.2	65.6	10.1	1.7	20.5	67.7	17.1	24.2	21.7	37.0

WIND RECORD — (*Concluded*).

DATE.	September.				October.				November.				December.			
	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.
1		2	8	6	7			23	17	1					7	7
2	3	2		14				10	17	1						18
3	1		8	14	2	5	2			18						8
4	15			1	8		10	5			2	19	6			18
5			11	7	5			12			2	22			9	12
6	12				5							24			4	16
7		1	14									10			15	8
8			2	18		14	2				8	2	2			22
9	7			13		7	9				7	11		7	6	
10			14	8			9		2			21		9	12	
11		2	19				9	1	7	2		6		8	16	
12			6	16								24			7	18
13				23								14			4	14
14				23	2	2	8	5		11	4		1	11		8
15	1			15	9			5		6	7	10		3	2	19
16		10	6			2	12		18			9				12
17			24			7	16	1		12	4			2	22	
18			21		6			11		1	15				15	1
19	8			2	3			21				15			9	15
20				18	4			19	8			21				14
21				22	4			12				7	0	0	0	0
22				22			18		1			12			2	
23	4	7	1	7			15		6					2	18	
24			12				8	4				5		8	8	11
25	4		15	5			6	4				24				21
26				24	2		9	8			1	17				23
27			1	21	10			1				14			4	5
28			16			3	11				11					7
29			7	12			2	18			1	8	4			20
30				24	6			14	1		2	2				24
31					4	5		1							12	7
Total hours of movement	55	24	185	310	77	45	146	175	67	52	64	297	18	45	167	318
Per cent of time in each direction	9.6	4.2	32.2	54.0	17.4	10.2	32.9	39.5	14.0	10.8	13.3	61.9	3.4	8.3	30.7	58.6

SUMMARY OF DIRECTION OF WIND FOR 1899.

	Northerly, N. W. to N. E.	Easterly, N. E. to S. E.	Southerly, S. E. to S. W.	Westerly, S. W. to N. W.	Total.
January	32	13	213	276	539
February	31	13	86	300	430
March	31	113	156	281	581
April	53	48	153	256	510
May	95	58	108	263	524
June	59	27	68	294	448
July	41	7	83	274	405
August	77	109	98	167	451
September	55	24	185	310	574
October	77	45	146	175	443
November	67	52	64	297	480
December	13	45	167	318	543
Total hours of movement	631	554	1,532	3,211	5,928
Per cent of time in each direction	10.7	9.3	25.8	54.2	....

READINGS OF THE STANDARD AIR THERMOMETER.

DATE.	January. 7 a. m.	January. 12 m.	January. 6 p. m.	February. 7 a. m.	February. 12 m.	February. 6 p. m.	March. 7 a. m.	March. 12 m.	March. 6 p. m.	April. 7 a. m.	April. 12 m	April. 6 p. m.	May. 7 a. m.	May. 12 m	May. 6 p. m.	June. 7 a. m.	June. 12 m.	June. 6 p. m.
1	8	3.5	7	1.5	10	11	30	31	29	28	32	29	64.5	72	63	71.5	82	78
2	9	14.5	23.5	10	26	21	27.5	34	34	26	26	27	60	80.5	70.5	60.5	71	67
3	23	34	34	22	24	25	32	41	41	28	35	33	50.5	55	55	62	73	66
4	41	44.5	47	18.5	23	23	37	40	38	28	39	36	41	64	56.5	63	73	85
5	35.5	36	26.5	19	27	21	43	53.5	32	29	38	36	43.5	67	57	70	89	83
6	22	24	32.5	16	21	19	25	36	44	29	42	46	50.5	68.5	70	73	86.5	78
7	16	21	15.5	11.5	20	15	23	29	29	40	45	38	53	69.5	64	72	83	77
8	6	21	35	14	15	6	18.5	27	27	33	38	38	50	62	62	72	79.5	75
9	19	16	10	−5	−1	−3	24	30	33	31	35	26	50.5	58.5	61	64.5	73	69
10	−2.5	3	1.5	−6	0	−4	28.5	37	37.5	30.5	43	41	47	70	68.5	56	75	68
11	−2	5	2	−7	3.5	0	43	49	45	32	51.5	53	58.5	59.5	68	58.5	73	75
12	10	23.5	29.5	−4.5	3	4	49	59	39	44.5	51	56	58	68	72	69.5	82	80
13	29	35	35	1	4	4	29.5	27	25	42.5	53	58	57	61.5	53	70	84.5	86
14	35	41.5	39	5	13	14	24.5	27	29	53.5	67	55	43	53	54	75.5	87	85
15	36	38	39.5	15	29	29	34	35	36	43	60	49	41	55.5	58.5	78	71	75
16	36	43	42	21	36	34	28	29	24	37	36	42	48	49	49	55	57	59
17	35	36	33	32	41.5	38.5	14	21	25	37.5	52	52	47	57.5	56	59	72.5	73
18	16.5	16	18	35	43	40	32	40	34	44.5	69	55	57	54	56	63	76.5	79.5
19	9	26	26	34	31	40	23	27	24	51.5	66	59	47	49	49.5	69	79	78.5
20	19	34	35	40	47	45	16	24	17	50	59.5	62	47	47.5	51	75	83.5	71
21	31	39	35	39	47	41	18	23	29.5	44	55	57	46	51	54	58	66.5	67.5
22	33	31	30	44	43	37	31.5	40	41.5	44	64	64	49.5	59	56	63	72.5	75
23	21	33	39	31	29	27	36	33	30	49	64	60	47.5	62.5	64	75	92	87
24	40	34	29	17	25	23	25	27	26	47	65	6[illegible]	54	72.5	70.5	72	84	74
25	23	23	24	17	29	28.5	23	30	33	54.5	6[illegible]	62.5	59	75	73	66	73	78
26	29	46	43	33	35	39	24	27	28	57	66	60.5	56.5	66	75	64	76	74
27	10	8.5	5	34.5	35	29	31.5	32.5	33	55	60	70	61	69	68	67	80	81.5
28	8	17	22	22	38	47.5	35	26	39	58	68	69.5	54	61	64	66	71	65
29	7	9	7.5	.....	....	.....	26	28	26	60	77.5	77	64.5	75.5	76	58.5	71	73
30	6	11	13	....	....	.....	23	30	32	66	74.5	78.5	67	73.5	68	60.5	75	74.5
31	−0.5	15	9	.....	....	....	27.5	33.5	33	...	...	....	64	79	78	....	......	...
Average	19.3	25.3	25.8	18.2	24.0	28.4	28.5	33.4	31.7	42.3	52.9	52.0	52.6	63.6	62.5	66.4	77.2	75.3

READINGS OF THE STANDARD AIR THERMOMETER — (*Concluded*).

DATE.	JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m.	6 p. m.	7 a. m.	12 m	6 p. m.	7 a. m.	12 m.	6 p. m.
1	65	84	87	66	82.5	75	70	72.5	70	37	42	43	45	45	46	46.0	52	40
2	72	90	91	72	84	75	65	68	65	35.5	42	41	30.5	35	32	40	45	45
3	73	91	92	70	84	80	69	84	78	32	47	47	32	40	43.5	36	38	33
4	78	91	78	73.5	86	83	56	65	68	44	65	58	36	45	42	31	31	28
5	74	84	75	70	77	73	59	80	80.5	50.5	63.5	57	41	44	39	20	24	25.5
6	70	69	67	65.5	79	76	62.5	67.5	63.5	43.5	61	54	37	42	40	26	26.5	20
7	67	77.5	78	65	73.5	72	54.5	74	78	38	53	51	36	52	43	14	26	28
8	66	73	68.5	68.5	73	72	70	68	64	43	57	56	37	52	49	37	40	39
9	60	61	72	61	76	75	56	66	62.5	52	56	58	35	52	50	20	26	28
10	68	79.5	80.5	64	74	79	49	70	69	45	66	60	46	47	41	33	36	40
11	63	82	73	66	82	84	60.5	59	64	53.5	65	65	36	36.5	35	43	39	51
12	68	80	80	74	86.5	74	62	72.5	62	52	68	68.5	28	30	29	54	55	48
13	61	72	70	65	76	72	51	54	56.5	54	73	72	30	33.5	30.5	37	45	35
14	67	79	81	63	71	63.5	45	56.5	52.5	58.5	78	72	30	36	34	28	26	27
15	66	80	79	56	75	74	43.5	60	61	59	64	63	37	43	40	22	25	21
16	73	79.5	79.5	65	79	79	50	73	73	54	77	65	41	38	35	22	27	24
17	69.5	79	73	64.5	86	84	64	80	79	59	71	65.5	33	45	45	23	35	35
18	64	75.5	75	68	87	86.5	62	78	78	54.5	59	59	46	56	54	32	40	39
19	61	67	67	70	90	83	64	66	59	51.5	61	53	48	52	47	47.5	37	33
20	60	73.5	78	73	92.5	83	59	58	57	42	47.5	43	38	38	38	21.0	40	37
21	76.5	87.5	82	75	94	72	53	61	58	34	40	37	31	46	43	30	41.5	37
22	68	74	71	70.5	76	75	57	65	57	30.5	47	50	46	47	44	29	44	37
23	66	76	79.5	62.5	66.5	69	48	59.5	57	47	56	60	34	38	37	32	40	42
24	67	80	81	65	74	78.5	60.5	65.0	68.5	57	76	73	37	37	36	40	36	34
25	69	79	80	69	85	80	67	73	60	50	69	70	34	36	36	19	22	15
26	70	84	85	68	82	77.5	49	47	42	60	72	69	34	38	38	12	16	14
27	80	81	78	66	67	63	44	57	54	52	54	47.5	39	43	42	15	20	19
28	66	79	79	63	78	78	47	65	62	49	60	61	41	39	36	15	24	19
29	66	83	84	67	80	80	52	45	44	50	47	49	43	45	41	13	18	18
30	65	74	74	70.5	83	80	39	50	42	45	54	51	44	43	43	0	7	3
31	62	75	76	68.5	85	82	......	......	......	39	47	43	......	......	......	8	11	11
Average	67.6	78.7	77.9	67.3	80.1	7.72	56.3	63.4	62.7	47.6	59.5	57.0	37.5	42.6	40.6	27.8	33.4	29.5

SUMMARY OF MAXIMUM, MINIMUM AND STANDARD AIR THERMOMETERS FOR 1899.

	Maximum.	Minimum.	Standard. 7 a. m	Standard. 12 m.	Standard. 6 p m.
	Ave.	Ave.	Ave.	Ave.	Ave.
January	30.5	13.7	19.3	25.3	25.3
February	27.1	13.6	18.2	24.9	23.4
March	37.5	23.2	28.5	33.4	31.7
April	56.8	36.3	42.3	52.9	52.0
May	68.7	46.4	52.6	63.6	62.5
June	82.3	56.6	66.4	77.2	75.3
July	82.9	59.5	67.6	78.7	77.9
August	83.9	59.2	67.3	80.1	77.2
September	71.1	50.0	54.3	65.4	62.7
October	63.8	42.9	47.6	59.5	57.0
November	45.4	32.3	37.5	42.6	40.6
December	33.5	21.5	27.3	32.4	29.5

READINGS OF MAXIMUM AND MINIMUM THERMOMETERS AT 7 A. M.

1890.	January. Max.	January. Min.	February. Max.	February. Min.	March. Max.	March. Min.	April. Max.	April. Min.	May. Max.	May. Min.	June. Max.	June. Min.
1	17.5	8	18	—1	49.5	20	38	26.5	80.5	58	82.5	63
2	11	1.5	18.5	1.5	35	20	34.5	24	87.5	58.5	85.5	61
3	24	9	27.5	10	34	27.5	34	23	82.5	48	73	52
4	41	23	27	18	46	32	39	25.5	59	38.5	76	55
5	59	35	25.5	15	43	33	41	26	66	36	88.5	65
6	37	21	27	10.5	53.5	18	40	24	73	43	93	62
7	34	14	23.5	10.5	38	25	50	29	73.5	41	91.6	66
8	22	6	21	11.5	30	18	46	28.5	72	48	90.5	70.5
9	36	4	11.5	—5.5	29.5	18.5	38	30.5	66	46	82	62
10	19	—2.5	0	—7	28	24	39	28	63	39	75.5	49
11	8.5	—3	0	—8	43	28.5	45	27.5	74	46	72.5	41.5
12	10	—4	5	—7	54	40	58	32	69	47.5	76.5	42
13	30	10	6.5	—4.5	63	29	65	37	74	53	84	63
14	33	26	10	1	29.5	28	57	42	73	37	89	68
15	49.5	35	18	5	34	24.5	70.5	36	61	32.5	90.5	67
16	42	32	34	15	41.5	28	55	33	59	39.5	84	50
17	46	35	37	21	31	14	50.5	29.5	55	42	66	52
18	33	15	44.5	32	32	14	55.5	37	63	47	76	47
19	17.5	8.5	45	32	42	27	75.5	44	60	44	82	58
20	33.5	8	45	30	28	15	69.5	49.5	50	45.5	83	57
21	33	19	52.5	36.5	24	18	66	39.5	51.5	45	86	53.5
22	45.5	29	47	36	32	18	58	40	56.5	43	78.5	49.5
23	33	21	47	31	44	30	71.5	43	61	42	79	60.5
24	41	21	31	16	36	25	65	48.5	68	41	93	60.5
25	41	23	27	16	30.5	20	67.5	47	74.5	47	88	62
26	29	19	34.5	17	33.5	22	73	51	76	50.5	82	54
27	47	10	44.5	29.5	32	24	69	44	79	56	80	51
28	10	1.5	36	20	36	18	76	47	74	54	65.5	59
29	24	8	......	......	39	25	74	44.5	69	53	66	51.5
30	12.5	2.5	......	......	30	21	82	57	84.5	59	75	52
31	16	—1	......	......	35	23	.....	.....	76.5	51.5	.....	.....
Average	30.5	18.7	27.1	18.6	37.5	23.2	56.8	36.8	68.7	46.4	82.3	56.6

1890.	July. Max.	July. Min.	August. Max.	August. Min.	September. Max.	September. Min.	October. Max.	October. Min.	November. Max.	November. Min.	December. Max.	December. Min.
1	78	60	80	56	89	65.5	50	35	47.5	37	54	36
2	83	57	87	63.5	75.5	64	45	33.5	46.5	30	55	37
3	94	59	89	64	72.5	62.5	47	26	39	27.5	48	35.5
4	97.5	71	87	64	92	55	52	30	47.5	30	39	30
5	93	68	90	68	68.5	47.5	72.5	42	47	35	32	19
6	88	63	78.5	57	84	58	65.5	47.5	45	34.5	27	18
7	75	58	81	51	70	41.5	63.5	35	46	33	27.5	18
8	81.5	64	75	58	81.5	54	60	35	55.5	34	39	18
9	81.5	59	78	47	71	52.5	58	42	54	34	42	19
10	73.5	59	79	55	69	43	61.5	41.5	57	34	33	18
11	84.5	58.5	84	63	75	49	72	44	48	33	43	32
12	83.5	59.5	89.5	66	68	53	70	49.5	38	27	60	42
13	81	56.5	91	62.5	72.5	50	71.5	51	32.5	27	56	35
14	72	55	77.5	56	61.5	40.5	78.5	58	34	25	47	25
15	83	54.5	78.5	44.5	57.5	38	56	58	37	28	33	21
16	84.5	64.5	80	47.5	66.5	40	67	58	50.5	36	26	15
17	84.5	66	85	52.5	79	49	79	53.5	42	27	30.5	17
18	82	58.5	91	58	87	59	73	54.5	48	32	33	27
19	79	59	92	60	84.5	61	66.5	49	60	44	47.5	30
20	70	50	97.5	65	74	56	63	41	54	37	49	20
21	79	60	97	65	59.5	49	48.5	33.5	39	28	45	23
22	91	60	95.5	66	67	48	45	26.5	48	28	46	27
23	75.5	59.5	78.5	62	69	43.5	50	30	50	33	48	28
24	83	56.5	71	61	62.5	47.5	63	45	43	33	43	30
25	84	66.5	83	63.5	70	60	81.5	48	37	33	41.5	18
26	88.5	68	84	61	75	48	79	49	43	33	25	6
27	89	65.5	87	65	50	39.5	76.5	49	39	33	20	10
28	82	58	69.5	56	59	41	55	47	43	37	33	14
29	86	58	82	57	70	47	65	48	43	31	34.5	10
30	86.5	55.5	83	62	52	38	56	39.5	48	36	18	0
31	75.5	54	85	62	......	......	57.5	37	......	.....	7	—1
Average	82.9	59.5	83.9	59.2	71.1	50.0	63.8	42.9	45.4	32.3	33.5	21.5

AVERAGE MONTHLY TEMPERATURE FOR TEN YEARS.

	January.	February.	March.	April.	May.	June	July.	August	September.	October.	November.	December.
1890	31.2	30.9	28.8	44.2	52.8	67.1	69.5	67.7	60.1	49.3	37.6	31.4
1891	25.9	28.3	30.8	45.3	52.0	64.4	66.4	68.5	66.2	48.8	38.4	35.5
1892	21.4	26.0	26.5	43.5	52.8	68.6	70.2	69.4	61.3	50.0	35.9	25.2
1893	15.5	20.6	29.5	41.1	54.1	68.2	69.8	68.8	59.0	52.0	38.2	27.5
1894	29.7	20.6	38.9	44.1	55.5	67.8	74.2	66.8	64.9	52.7	36.0	31.5
1895	21.8	16.9	26.9	44.4	59.0	†	†	71.2	61.7	45.4	39.6	31.4
1896	22.4	24.1	24.4	49.3	62.0	65.9	71.4	70.0	60.2	46.5	42.9	27.1
1897	23.2	26.1	33.8	45.1	55.4	62.4	73.5	67.6	62.4	52.6	39.7	29.2
1898	26.2	26.8	*	48.2	57.0	67.7	74.2	71.0	65.9	52.1	37.9	27.9
1899	23.1	20.4	30.4	46.6	57.6	69.5	71.2	71.6	60.6	53.4	38.9	30.0

* Maximum thermometer broken. † Record lost from June 18 to July 11.

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REPORT

OF THE

BUREAU OF

FARMERS' INSTITUTES.

F. E. DAWLEY, Director.

Transmitted to the Commissioner of Agriculture, pursuant to Chapter 338, Laws of 1893.

ALBANY:
JAMES B. LYON, STATE PRINTER.
1900.

List of Farmers' Institutes for 1899.

PLACE.	County.	Date.	
Mineola	Queens	January	2–3
Georgetown	Madison		3
Camden	Oneida		3–4
Northport	Suffolk		4
Higginsville	Oneida		4
South Otselic	Chemung		4–5
Bridgehampton	Suffolk		5
Taberg	Oneida		5
Riverhead	Suffolk		6–7
Mexico	Oswego		6–7
Cincinnatus	Cortland		6–7
Cortland	Cortland		9–10
Florida	Orange		9–10
Sandy Creek	Oswego		9–10
Woodville	Jefferson		11
Monticello	Sullivan		11–12
Marathon	Cortland		11–12
Adams Centre	Jefferson		12–13
Upper Lisle	Broome		13
Walden	Orange		13–14
Belleville	Jefferson		13–14
Sodus	Wayne		16–17
LaFargeville	Jefferson		16–17
Greene	Chenango		17–18
South Onondaga	Onondaga		18–19
Hammond	St. Lawrence		18–19
Williamson	Wayne		18–19
Conklin	Broome		19
Madrid	St. Lawrence		20–21
Bainbridge	Chenango		20–21
Webster	Monroe		20–21
Antwerp	Jefferson		23–24
Fayetteville	Onondaga		23–24
Spencerport	Monroe		23–24
Cooperstown	Otsego		23–24
Schenevus	Otsego		25–26
Rochester	Monroe		25–26
Gouverneur	St. Lawrence		25–26
Attica	Wyoming		27–28
Lowville	Lewis		27–28
Altamont	Albany		27–28
Cherry Valley	Otsego		30–31
Denmark	Lewis		30–31
Constableville	Lewis	February	1
Middleburg	Schoharie		1–2
Esperance	Schoharie		2
Trenton	Oneida		3
Quaker Street	Schenectady		3
Norway	Herkimer		4

FARMERS' INSTITUTES—*(Continued).*

PLACE.	County.	Date.	
Pattersonville	Schenectady	February	4
Voorheesville	Albany		6–7
Cazenovia	Madison		6–7
Canastota	Madison		8–9
West Sand Lake	Rensselaer		8–9
Clarksville	Albany		9
Ithaca	Tompkins		10
Stuyvesant Falls	Columbia		10–11
Union Springs	Cayuga		10–11
Waterloo	Seneca		13–14
South Bethlehem	Albany		13–14
Clifton Springs	Ontario		14–15
East Greenbush	Rensselaer		14–15
Clifton Park	Saratoga		15
Caledonia	Livingston		16–17
Gansevoort	Saratoga		16–17
Fayetteville	Onondaga		17
Batavia	Genesee		17–18
Ketchum's Corners	Saratoga		18
Minaville	Montgomery		20
Arcade	Wyoming		20
Warsaw	Wyoming		21
Hagaman	Montgomery		21
Eastern N. Y. Horticultural Society	Albany		21–22
Warsaw	Wyoming		21–22
Castile	Wyoming		22
Johnstown	Fulton		22
Pike	Wyoming		23
Mayfield	Fulton		24
Glen	Montgomery		24
Franklinville	Cattaraugus		24–25
Rural Grove	Montgomery		25
Fort Plain	Montgomery		27–28
Olean	Cattaraugus		27–28
Gonverneur	St. Lawrence		28
Bellona	Yates	March	1–2
Fulton	Oswego		1–2
Cuba	Allegany		1–2
Lysander	Onondaga		3
Friendship	Allegany		3
Prattsburg	Greene		3–4
Hannibal	Oswego		4
Ira	Cayuga		6–7
Angelica	Allegany		6–7
Spring Valley	Rockland		6–7
Canaseraga	Allegany		8
Pine Bush	Orange		8–9
Auburn	Cayuga		8–9
Canisteo	Steuben		9
Seneca Falls	Seneca		9–10
Ovid	Seneca		10
Washingtonville	Orange		10–11
Rathbone	Steuben		10–11
Ovid Centre	Seneca		11
Lodi	Seneca		13
Big Flats	Chemung		13–14
Fishkill	Dutchess		13–14

FARMERS' INSTITUTES—*(Continued).*

PLACE.	County.	Date.	
North Hector	Schuyler	March	14
Millbrook	Dutchess		14–15
Alpine	Schuyler		15
Milton	Ulster		15–16
Wellsburg	Chemung		15–16
Moore's Mills	Dutchess		16
Watkins	Schuyler		16–17
Savona	Steuben		17–18
Rhinebeck	Dutchess		17–18
Tyrone	Schuyler		18
Auburn	Cayuga		19
Penn Yan	Yates		20–21
Avoca	Steuben		20–21
Hilton	Monroe		21
Cohocton	Steuben		21–22
Lyndonville	Orleans		22–23
Hall's Corners	Ontario		22–23
Livonia	Livingston		23–24
Bristol Springs	Ontario		23–24
Gasport	Niagara		24–25
Fishers	Ontario		24–25
West Henrietta	Monroe		25
Syracuse	Onondaga		25
Palmyra	Wayne		27–28
Albion	Orleans		27–28
North Manlius	Onondaga		27–28
Rochester	Monroe		29–30
Pattersonville	Schenectady	April	14
Summit	Schoharie	May	22–23
Beards Hollow	Schoharie	June	7
Barnerville	Schoharie		10
Grovernor's Corners	Schoharie		13
Reading Centre	Schuyler		13
Summit	Schoharie		22
Palmyra	Wayne		24
Rock District			27
Sharon	Schoharie		29
Rushford	Allegany	July	11
Breakabeen	Schoharie		25
East German	Chenango	August	2
Lowville	Lewis		4
Jordan	Onondaga		9
North Franklin	Delaware		9
Charlton	Saratoga		10
Pitcher	St. Lawrence		16
West Sand Lake	Rensselaer		17
Mt. Kisco	Westchester		17
Fox Ridge	Cayuga		18
Edwards Falls	St. Lawrence		18
Clarksville	Albany		18–19
Plattsburg	Clinton		23
Lyons	Wayne		23
Navarino	Onondaga		24
Tully Lake Park	Onondaga		26
North Harpersfield	Delaware	September	1
Gilboa	Schoharie		12
Lowville	Lewis	October	14

FARMERS' INSTITUTES—*(Continued).*

PLACE.	County.	Date.
North Ridge	Niagara	October 28
Ithaca	Tompkins	November 13
Geneva	Ontario	14-15
Parish	Oswego	16
Waterloo	Seneca	16-17
Oswego	Oswego	17
Union Springs	Cayuga	17-18
Pulaski	Oswego	17-18
Woodville	Jefferson	20-21
Delhi	Delaware	20-21
Nelson	Madison	20-21
West Eaton	Madison	22-23
Rodmau	Jefferson	22-23
Hobart	Delaware	23
LaFargeville	Jefferson	24
Stockbridge	Madison	25
Jefferson	Schoharie	25
Clayton	Jefferson	25
North Harpersfield	Delaware	27
Plessis	Jefferson	27
Hamilton	Madison	28
Gilboa	Schoharie	28
Gouverneur	St. Lawrence	29
Grand Gorge	Delaware	29
Sherburne	Chenango	29
Hammond	St. Lawrence	December 1-2
Halcottsville	Delaware	1-2
Syracuse	Onondaga	2
Lexington	Greene	4
Rockdale	Chenango	4
Lisbon Centre	St. Lawrence	4-5
Hensonville	Greene	5
Morris	Otsego	5-6
Rochester	Monroe	5-7
Madrid	St. Lawrence	6-7
Durham	Greene	6-7
Walton	Delaware	6-7
Bainbridge	Chenango	December 8-9
Winthrop	St. Lawrence	8-9
Breakabeen	Schoharie	8-9
Clarence Centre	Erie	8-9
South Bethlehem	Albany	9
Afton	Chenango	11-12
Collins Station	Erie	11-12
Franklin	Delaware	11-12
Nicholville	St. Lawrence	12-13
Union	Broome	12-13
Lisle	Broome	13
Cottage	Cattaraugus	13
Bombay Junction	Franklin	13
Corbettsville	Broome	13
Conklin	Broome	13
Chappaqua	Westchester	13
Batavia	Genesee	13
Ellington	Chautauqua	14
North Bangor	Franklin	14
Canandaigua	Ontario	14-15

FARMERS' INSTITUTES—*(Concluded).*

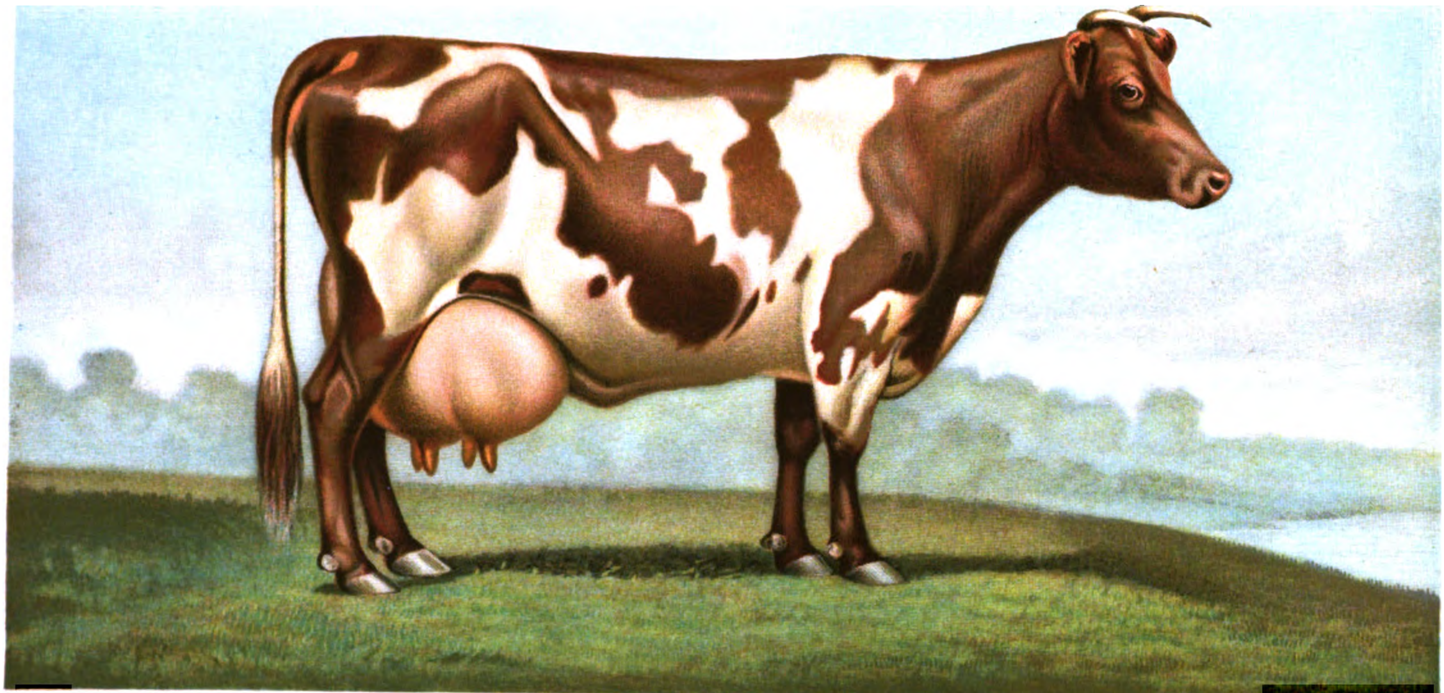
PLACE.	County.	Date.
Cortland	Cortland	December 14–15
Chateaugay	Franklin	15
Cattaraugus	Cattaraugus	15–16
Ellenburg	Clinton	16
Moore's Forks	Clinton	16
Tully	Onondaga	16
Cincinnatus	Cortland	16
Pompey Hill	Onondaga	16
South Otselic	Chenango	18
Jamestown	Chautauqua	18–19
West Chazy	Clinton	18–19
Fulton	Oswego	18–19
DeWittville	Chautauqua	19
Romulus	Seneca	19
Georgetown	Madison	19
DeRuyter	Madison	20–21
Hannibal	Oswego	20–21
Sherman	Chautauqua	20–21
Plattsburg	Clinton	20–21
Auburn	Cayuga	21
Willsboro	Essex	22
Weedsport	Cayuga	22–23
Fredonia	Chautauqua	22–23
Putnam	Washington	23
Rock District		26
Marcellus	Onondaga	26–27
Vernon	Oneida	26–27
Cuba	Allegany	27–28
Cooperstown	Otsego	27–28
Clinton	Oneida	28–29
Skaneateles	Onondaga	28–29
Chadwicks	Oneida	30
Barnerville	Schoharie	30
Mandana	Onondaga	30

Judging Cattle in the Show-Ring.

By Dr. G. M. Twitchell, Augusta, Me., at meeting of New York State Breeders' Association, held in Rochester, N. Y., Dec. 6, 1899.

Success in this world is possible only through our ideals. In proportion as the picture in the mind is clear before the artist, manufacturer or builder is it possible for energy and intelligence to be correctly and satisfactorily applied. Out of great conceptions alone come great results. Every step in the world's progress has been the outcome of large ideals in the minds of leaders. Sometimes men have stumbled on great truths, but these have been retained only as the conception of their worth and magnitude has fixed itself in the minds of intelligent leaders.

One of the most difficult things for a man to do is to break company with an old practice and establish himself in new lines of work. The tension of years holds firmly and when the thought of change comes and habits are broken, the danger is of drifting, and this is likely to carry to the opposite extreme. Men, especially those who live largely by themselves, get most firmly grounded in their practices and find it very difficult to see the merit of what is clear and open to others. Go back to the first report of this association and note to what a degree the leaders of that day outlined what we are to-day urging, how from that time to the present the one thought of progress, along the lines of present demands, has been the objective point towards which they have sought to urge the people. Ever the truth has been the same, though year by year there has come better and still better appreciation of what that truth was, and how it could best be applied to the needs of humanity. The old time conception was sufficient unto its day and generation; the newer is demanded to-day in every field of activity. It is truth just the



JAMES B. LYON, STATE PRINTER.

AYRSHIRE COW, DUCHESS OF SMITHFIELD, NO. 4256.

FROM REPORT
U. S. BUREAU ANIMAL INDUSTRY.

same, but it comes in new dress, it centralizes and focuses on specific points and parts, it divides and subdivides, for the reason that as we probe into closer relation of things, we find that, in the perfection of our knowledge of parts alone can we, in any true sense, grasp the perfection of the whole.

Have we ever paused to consider, as we should, how completely man may comprehend and control the most intricate problem of commerce, of manufacture, of art and music, and also how the greater his knowledge, the deeper his researches, the more faithful his investigations, the more profound will be his appreciation of the mysteries which surround and develop his every step along the pathway of agriculture. More than this are we fully alive to the fact that as we grope, using our best knowledge, we find the way opening for greater and still greater results, results which are all the while bringing increasing blessings to the world. We stand amazed at the marvelous, which is made plain to our understanding by the delvers in the realm of nature, yet they are but putting together the fragments, but coming to a realization of the great harmony which exists throughout. They are not changing, but appreciating what is, and seeking to conform to nature's requirements, out of this knowledge building for the good of future generations. It is simply getting at the harmony of things which alone makes possible improvement.

Anything and everything which will aid in strengthening faith in the underlying verities, stimulate ambition to grow, arouse competition along lines which lead to better stock and products, educate towards an appreciation of what must be taken in its entirety in order for the man to be a man in the best sense of the term—all this is demanded in the field of active duties today, and will be in all the days before us. Hands are to be but willing servants of active brains The power which lifts the standard of production or rate of speed brings to the forefront added lines of beauty, and a higher degree of intelligence must have keener appreciation and a clearer ideal. Have we ever thought that it is only in our ideals we are to find safety, and no where else, whether it be in the field of the moral or me-

chanical. They are at the foundation of advancement. The era of muscle has been superseded by the era of brains. All the conditions of trade conspire and inspire towards a higher standard. Whatever our fancies, practices and natural inclinations, there are outward conditions ruling in all departments of commerce and manufacture which govern the farmer as well as the tradesman. The farmer is not merely a producer to-day, whatever he may have been in the past. Out of his manifold forms of improved machinery, by which he is able to increase output, he becomes a manufacturer, and the laws which govern in the realm of manufactures govern in that of agriculture.

Not alone profit out of sales, but saving in cost of manufacturing, whether it be milk, butter, wool, fruit, farm products or poultry, saving in wastes, saving in labor, both of machine and man—this is what gives success in the shop and mill, and this alone will suffice on the farm. The necessity for constant study of details, close watch on all departments, constant weeding out of the least profitable, seeking for reduction of friction in operating, is appreciated on the one hand, else there could be no successful manufacturers; it must be grasped in its fullness if there is to be satisfaction and permanence on the farm.

It is no new thought I am giving utterance to, but simply the presentation of a principle, accepted but not governing, else there would be no call for the discussion of this system of measuring values at our exhibitions.

We have reached unnatural conditions in the breeding of all classes of live stock. Functions natural in their origin have been intensified, divided, subdivided and marvelously increased through the ideals of men backed by the dominant will of an objective mind. The exalted position maintained to-day by individuals and herds is not accidental, neither is it permanent. The higher levels are secured and maintained only by persistent application of one's largest conceptions, the subjective mind yielding surely to the positive influence of the clearly defined ideal in the mind of the master. To-day I plead for this ideal, necessary as never before, in order that the forward steps taken by the seers and

prophets in breeding may become the standing ground of the great mass of breeders. Altogether too large a per cent. of our animals, of all breeds, must be stamped purposeless, partly from lack of skilled breeding, but more for want of skilled breeders. The standard of every breed is to be measured by the highest level reached by any individual breeder who seeks to secure and fix the essential qualities recognized by the fancier, and those also demanded in the actual tests which determine merit. The unmistakable evidence of marked family characteristics only emphasizes the lesson of the hour.

Animal life, like clay, yields readily to the hand and eye of the skilled worker, but, as the standard rises, the plastic nature becomes more positive in its type, as it grafts on the mental conceptions of the man at the head. Gentlemen, the day has arrived when the true breeder must be reckoned an artist, for under his touch he is painting color of hair, skin and membrane, shaping form, developing beauty and perfecting symmetry, while all the time intensifying those organs which alone can insure rapid and heavy production or growth. Alongside the great painters and singers are to be placed the seers in breeding, who have founded herds and established families noted not only for breed and type characteristics, but alike for great individual worth as producers. They fill the stalls in every breeding establishment, they are multiplying on every hillside, they are adding wealth to the farm homes of the world, and, more than all, they are waiting to be led out into larger fields of service as men come into clearer appreciation of fundamental principles governing development.

Consciously, or unconsciously, we measure an article, individual or animal, at the first glance. Why we like or dislike we may not be able to state, but the impression is there, and future examinations seldom change the result. This intuitive perception may be more keen in the minds of some than others, but it is the safeguard of the world. Out of it have come the results of the present in every field. Searching for the why and how, men have been led out into larger conceptions, where ideals have taken

more definite shape. All do not have intuitive perceptions in the same direction, but all do have intuitive perceptions in some direction. In judging, we always measure by our ideal. It is the only safe standard; it is what we would have if we could transform to suit our fancy. No matter what the system, whether in public or private, here is the bar of justice to which the individual animal or product is to be brought.

Granting these premises, what is their application to the topic of the hour? Just this, that the method of judging should be that which will be of greatest service to the individual owner and exhibitor in the to-morrows before him. Men may come and go but breeding is to continue, and always along the line of improvement, simply because our necessities will force us up and on in the study of animal economy and the appreciation of animal machinery. Have we come to the full standard of our ideals; if so there is no future for us, and we are but cumberers of the earth. If not, then is there a call for the bringing out in clear and unmistakable lines that ideal which we would create and establish, an ideal of form, courage, intelligence, service, and as we reach after and seek to grasp its outlines, they will still float in the upper realm of our consciousness, but the standard we shall attain to will gradually rise toward the ultimate in quantity and quality.

It is the natural tendency with men working alone to drift unconsciously into fixedness of habit. The evil attending this is recognized. Out of this condition comes the low standard of production, the large per cent. of unprofitable stock, the quantity of inferior products, the evidence of a want of appreciation of the best means and methods of marketing—whieh, to-day, is fully one-half the story. Out of this condition comes the opposition to books and newspapers, the feeling that agricultural colleges and experiment stations are fads and not necessities, expensive luxuries which may benefit the few but cannot be of service to the many. All this is to my mind perfectly natural, and while we can see a great advance, as we mark the milestones of the past, there is needed a getting down to simple problems and a study of parts in sole relation to the whole, and with the one thought

of purpose. When in our examination we take up the evidences of temperament, there is opportunity for close observation in determining fitness for any special service. Between the nervous and phlegmatic there are many shades, and to classify so that each shall have credit calls for skill, the result of practice. Yet it is just this skill which the milk producer or dairyman must have if the weeding process so necessary is to be intelligently applied.

The pathway of human experience is strewn with wrecks where the cold phlegmatic man has attempted to fill the sphere set apart for his nervous neighbor. Large production in our dairy cows is found only in the more highly nervous organisms. If this be balanced by intelligence, then we have the profitable producer. So is it with the driving horse, the egg-producing hen, and there must be some method by which, in our annual fairs, these elements of success may be made clear to the man who has not yet entered into an appreciation of the importance of these relations. The worth of the individual will always settle the question of the worth of the herd, and to bring out the individual characteristics of each one is legitimately within the scope of the score card.

We need to fix permanently in mind the fact that form governs purpose and that there is no place in the economy of the closing days of this nineteenth century for a man or an animal which is not built for something specific. So important is it that we must graft this thought into the warp and woof of our being, if we are to stand successfully in the competition of the next twenty-five years. No one opportunity offers such advantages for getting clear and unmistakable evidence of what is demanded to-day as the annual exhibition; but to realize the most, a man must be a competitor and not an indifferent visitor, and the system of awarding premiums one which will furnish the greatest possible amount of information, not only of the strong, but especially the weak points in his animal or product. It is this and this alone which will educate, which will improve and advance. There are valuable animals in every herd. Are they the result of well-directed efforts or are they accidental products? If the latter,

then by a better knowledge of parts we need come into a more complete appreciation of how these accidents came, that well-directed effort may more rapidly increase the individual value of the herd. So the scale of points and score card fit naturally into the daily work of every breeder seeking to improve. The man with the card in hand who is to award the premium may not be as much an expert as the man who holds the halter, but the responsibility is on him to put his estimate on every part in accordance with the standard of perfection, and then place his name at the bottom of the card. Few men will show favoritism in such a field. More than this, these cards are the safeguards of the expert, as they furnish the story of his work in detail. In case of errors, the remedy is easily applied and justice done to every exhibitor.

Instead of comparing animal with animal and forgetting the points of difference, as must be the case as soon as the class drops out of sight, we have here the full record to be retained for the protection alike of the society and the expert.

As we are to consider the subject with reference to competition, the object of competition must be clearly recognized. I assume that the mercenary spirit, the winning of a dollar, may properly be set one side, for if it enters it dwarfs and destroys all possibility for competition to be of service. The man whose sole purpose in exhibiting is to win honors and dollars is not a breeder, but a camp follower. His herd will retrograde inevitably, for his conception is purely selfish, and while selfishness plays no part in the development of a producing herd or animal, it always stands as a bar to progress. Competition for intelligent comparison is educative, and education lifts ideals and broadens vision. For this to be possible the association under which an exhibition is held owes to the exhibitors certain specific things:

1st. Ample room for protection of stock, and examination of same by the public.

2d. Generous advertising of individual exhibits.

3d. Permanent and ample pens for judging, with seats for interested spectators.

4th. A system of awarding prizes which will insure justice to the individual exhibitor, and at the same time furnish to him and the public the reasons leading to giving or withholding an award.

5th. An expert to award the prizes who shall be required to remain one-half day after the work is completed to meet disappointed exhibitors.

6th. A blackboard on which the sectional values shall be placed as given by the expert, where all who desire can follow the work in detail, and be led to question the decisions.

Breeders are sharp and shrewd, looking after their own interests, but they are reasonable men all the while, and if they question an item in the score, the expert, if he be worthy the place, will, by pointing out the defect, satisfy the owner or correct a mistake. The greater the publicity the less cause for criticism after awards are made.

If the object be to promote agriculture, stimulate love for better stock, and strengthen purpose to procure the same, then the show ring becomes the one great object lesson of the year, and the system of judging the educating influence. I assume that we have passed out of the old custom of appointing a committee of three, and recognize the certainty that a single judge in a class insures more satisfactory results, providing the full record of his work is secured for the exhibitors. We are discussing animals, not owners, and the awards should be so placed that the cry of favoritism cannot be raised.

Two systems of awarding premiums are before us, the comparative and the mathematical. The advantages of the former are that the work can be more rapidly performed, the ribbons placed in less time, and expenses reduced. The disadvantages are that no evidence is furnished as to the reasons for giving or withholding, that there can be nothing educative under such methods, and it is impossible to prevent the charge of favoritism.

The advantages of the scale of points and score card are not that the awards are placed more equitably, but that the full evidence is on record, part by part, a copy to be furnished the exhibitor, for each animal scored, that the study of parts thus stimu-

lated will surely lead to a more equitable balancing of the whole, preventing the natural tendency to over or underestimate, and forcing the conviction that the value of the animal lies in the sum total of the value of the several parts indicated in physical and mental make up. The disadvantages of this system are the difficulty in making equitable mathematical calculations, determining the per cent. of value in each part, and measuring the individualism of the individual, something not easily put on paper, simply because partly intuitive.

A perfect system for awarding prizes has not yet been devised. Human intelligence has not yet compassed the whole problem, and certain inequalities must surely be noted; but when the necessity for a sharper insight into the worth of parts of the great machine is recognized, and the certainty that a study of parts, and the relation each bears to the others, is sure to stimulate the breeding of still better animals, the possibilities of the score card, both as an educator and promoter of good judgment, must, I believe, be admitted by all.

The criticism made that no two judges place the same value on parts has little weight, all the exhibitor at any exhibition can ask being that the expert preserve an equitable ratio of values in placing the awards. If another expert scores higher or lower, it is no argument against the system, it simply speaks of individual estimates. If on another occasion the figures are changed, it only confirms what has already been indicated. Criticisms of this class are captious, failing in that they belittle the educational feature of the score card while magnifying the arbitrary ruling of that method which furnishes no reason for judgment. If exhibits at our fairs are to be maintained, and the number of exhibitors increased, this question of judging by some system which will return to the individual owner full evidence of the estimate of the expert upon his individual exhibit must be perfected. Under the committee and comparative system the rights of exhibitors are altogether too much ignored, the work of judging is hurried, and would-be successful breeders become discouraged and drop out.

The exhibitors make possible your exhibitions, and they are entitled to all the evidence in every case where an expert sits in judgment. The responsibility is upon fair managers to provide not only reliable experts, but some system by which the awards may not only be placed in justice, but all the educational benefits possible secured to every exhibitor.

In the breeding of to-day utility swings to the front as the chief standard of merit. For this to be secured and perpetuated the importance of careful, painstaking, systematic breeding must be everywhere insisted upon. The standards of growth and production must be raised next year, and prepotency in transmitting desirable qualities inhere in all our blooded stock in larger degree than ever. For this to be recognized and made positive to the breeder every score card should carry the reasons of the judge for his cut on any part, and so full a description of each section that perfection will be placed above the line of present attainments. The man who can find nothing to change in an animal or product, and so gives perfection on parts, is not an idealist, has no high conception of perfection, and while for the time he may please the vanity of the breeder, his influence is sure to dwarf judgment and lower the standard of excellence. With the fact before us that the sharp competition of the future will necessitate larger output and finer quality in order to secure desired revenue, the obligation falls clearly and sharply upon the breeder to enter into closer sympathy and clearer comprehension of the intelligent machine spending itself for his blessing.

There's a wonderful degree of satisfaction and assistance to be obtained from a close study of cow and horse, hog and hen physiognomy as well as anatomy. Nothing will so rapidly bring a man into close sympathy and fellowship as when he is seeking to come into, and unto, an appreciation of the traits and trends, the thoughts and aspirations, and, more than this, hindrances which make up the forces at work in the animal constitution. We talk about being helped or hindered by our environments, but, do we stop to consider the environments of the dairy cow

from which we are seeking to reap a harvest of gain, or the horse which never falters or fails of the best there is in him.

The whole line of production has become so abnormally unnatural that the man at the helm must be in touch with more of the forces at work in the bodily structure of his animals, if he would control and increase production, size, rapidity of growth, style, or speed. The measure of each is simply the measure of the man. He is to be master of all, and because of this we touch here, in this study of parts, one of the greatest problems which can confront the breeder or grower.

Perfection is and always will be before us. In this fact lies the only incentive for growth and improvement, and it is the weak, not the strong side of our animals which afford opportunity for the higher skill of man to be felt in improvement. Therefore whatever will tend to make a man more critical, more observant, more enthusiastic, more intelligent, is a help and a necessity. Each individual animal and product varies in some point or part peculiar to itself, and it is only in the summing up of the whole that one can decide what is best. One cow is built along the best dairy lines save that a heavy, beefy brisket shows itself, and we wonder why she fails in her milk production at a time when we expect much. There is her weakness as a dairy animal, and the force of some beefy ancestor is felt as the period of lactation increases. Another is light in brisket, but while carrying the same dairy form in general, is stout and heavy in neck, and again an obstacle presents itself to check production. Put these two cows before a critical committee, in a field of cows as good as they, in other respects, but better in the two mentioned, and the owners of these two will criticise when the ribbons are distributed. Such weaknesses in confirmation would hardly be carried by members of a committee day after day, and to give the reasons for the award, a week after the gates closed, would be an impossibility. Give your judge the score card and the record in all future time will tell the story for itself.

One or two other points call for discussion. The time will come when breeders will demand, and societies will grant, more

time to this work of awarding premiums, when we shall see its important bearing upon all progress and by the use of more individual judges be able to take up more effective work. If the object be to educate, then the exhibitor has the right to demand that the greatest possible amount of information be furnished by the men who are to award the ribbons. Money spent in this way will be productive of greater benefit to the state than for the usual round of amusements. Let the expert, as he goes to his work, take with him a boy and a blackboard, and as he marks up the scores on the cards, let the boy mark up the board. If the scores differ, the questions will be forthcoming, and right here we touch what seems to be ideal work along the line of substantial growth. It will require time and patience, but the man who contributes the stock has as good a right to faithful service as any other. Too long these rights have been neglected, because not demanded. Let the fullest discussion be fostered. There will be no awarding to owners in such a field, and the only point of variance will be that of judgment. Here the expert protects himself and the society by his record.

Until the time comes when this is possible, the experts should remain on the grounds at least one-half day after their work is completed, in order that disappointed exhibitors may seek them out and satisfy their wishes for information. On such occasions it is well to bring the animals together and indicate clearly the points of difference and the reasons for the awards. If the horse or cow has a large, coarse ear, a Roman nose, a thin or extremely thick lip, let these be indicated, and their effect upon disposition, which has so much to do with service, made plain. If you find the walls of the abdomen thin and drawn, the muscular development deficient, let the fact of lack of vitality be made clear to the grower or breeder. Falling back on the proposition that form must govern purpose, and that each and every part bears relation to every other, the force of these homely illustrations must be admitted.

But, you say, are these things necessary? Have we not seen good horses with Roman noses or dished faces, straight hocks or

crooked; cows with heavy briskets or meaty shoulders, coarse ears and narrow thighs, which were good producers? Yes; surely we have, but whether they were the exceptions to the rule or not, the day has come when the currents must be controlled, in all our animals, to a larger degree than ever before, and to do this there must be a greater harmony of parts and a more perfect adjustment. Like the more intricate machinery necessary for the skilled workmen successfully to compete in the markets, that through reduced friction there may be a greater ratio of speed or, by more equal bearings, less false spots in the fabric, so in the profitable production of stock, or any of the farm products, there is demanded a better knowledge of the relation each part bears to every other, in order that the per cent. of waste, either in time, food or labor, may be reduced to the minimum and the quality of the output made most favorable for the success of the grower or manufacturer. From beginning to end the thought of business must be engrafted on every step. Admitting that there are problems in the animal economy not yet solved, and surely not to be controlled, may we not with justice claim that the measure of our ignorance is largely in proportion to the measure of our want of appreciation of the underlying principles at the foundation of this paper. I would, if possible, make imperative the necessity for this study of farm products by a scale of points and the use of the score card, for the simple reason that it lies at the root of successful farm husbandry, and the best system to be used in the awarding of premiums at any agricultural fair is the best for the individual to use in the more detailed study of animals and crops at home. The weaknesses of the system will disappear as one gets into sympathy and appreciation with the foundation on which it rests. It makes men more critical, more observant, more attentive to seemingly trivial things, and less likely to be carried away by some fancy point, made prominent, but having only a superficial bearing. There is danger that single parts will be magnified until their relation is lost. Thus one will be swept away by the switch of the Jersey, the knee action of the horse, the number of spikes on the comb of the Leghorn, or the beautiful

color of the fruit. All these are of value, but do not determine worth. They are only fractional parts of a great whole. Another will ask only of production in the dairy cow, the record made by the horse, the weight of the hen, or the number of eggs, and the yield of the tree. These he will declare are essentials and nothing else can be. Is this true? Are we not called to look below the surface and learn more of the ground work on which the animal or tree stands. A friend, one of the large wholesalers, makes it a rule whenever a boy applies for a position first to study the boy and then study his mother. In the right blending of the natural traits and characteristics of the individual with those inherited from his ancestors, we are likely to find greatest excellence. Sure it is that along this line alone will progress be made in succeeding generations. Present so-called fancy points must give way for the substantials, and the standard moved up where it will bear solely on the question of merit. Color of tongue or switch, width of stripe, number of spots, or other arbitrary markings, unless they add to the intrinsic worth, must be set one side, and how is this to be so easily determined save by giving to each its true value and allowing the sum total to settle the worth of the whole. The superiority of the scale and score card will readily be admitted, but I make this plea for more systematic work in awarding premiums and for extended and critical examination by the state, through organized bodies, for two reasons, either of which justify the action:

1st. Because it is necessary in order to establish justice between exhibitors and place awards in accordance with merit.

2d. Because of the imperative necessity for raising the standard of quality in all products.

The day has gone, never to return, when we may expect largely increased prices for farm products. The outsweep of trade is touching the uttermost corners, and bringing them into close relations with the farms. We do not question to-day whether the onions grew in Egypt or New York so long as the price is not increased. For years we have been approaching this lower range of prices and values. It is one of the conditions of our outreach-

ing civilization, and therefore inevitable. At the same time, in the wisdom which has ordained that man shall earn his bread by the sweat of his brow, it is established that there has been, is, and always will be, two conditions, the only limitations being the skill and intelligence of the individual—one is that of production and the other that of cost of production. The farmer faces these two unknown quantities, and the higher he reaches in output and quality, and the deeper he digs into the mysteries of food nutrients and food combinations, the surer and the greater will be his measure of profit, in all the years to come. It will be the putting together of the fragments here and there which will lead to better knowledge and therefore better methods, and again we are forced back upon this business proposition which lies very close at the root of the whole question. Greater skill comes only as the result of keener insight and more knowledge. These are not to be obtained save as one grows into an intimate acquaintance with the laws and conditions governing, seeks patiently to learn their relation to each other and the part each bears to the whole, and out of well-balanced judgment and experience applies this knowledge in the daily walks of life. This is the man who will always be master of the situation.

The Proper Beef Type.

Delivered before the New York State Breeders' Association, at Rochester, N. Y., by Prof. C. F. Curtiss, Ames, Iowa.

I wish to say at the outset that the impression that the success of mastering the great problems in the field of agriculture does not require special preparation and fitness as well as careful study and a high order of ability, is altogether erroneous. The idea that successful farming does not require a trained mind and the highest degree of intelligence, judgment and reason never had any foundation in fact. Robert Bakewell said over a hundred years ago that it was easier to find a dozen men fit for cabinet positions than one good judge of live-stock, and the conditions haven't changed very much even to the present day. Has it ever occurred to you that the ability simply to judge stock accurately and well is at least of a rarer kind, if not of a higher order, than that which interprets the laws of a nation. The men who are employed to pass judgment on the live-stock that goes to the great markets of this and other countries, men who are required to know simply one thing and know it thoroughly, command a higher salary than men who preside at the bar of justice in the highest courts of the land. This may seem like a striking statement, but nevertheless its truth is fully attested by the records and salaries paid for these positions; and if you were to hunt the country over, I will guarantee that you would find a hundred per cent. more men competent to serve as judges in the highest courts than are qualified to pass accurately on the real value and utility of live-stock. The men who are employed to do this work at the great market centers are thoroughly trained experts. They must be able to determine almost at a glance just how much and what kind of a product an ani-

mal will cut on the block, and the work will permit of no inaccuracy. Their judgment and the training of their mental faculties involve thousands and almost millions of dollars in a single day. Why should not a breeder and feeder have the same discriminating judgment? In other words, why is not the work of breeding, feeding and selecting domestic animals more of an exact science? Simply because of lack of training. To put it in other words and more plainly, men fail to breed good animals primarily because they do not know what they are—because they have wrong conceptions and wrong ideas of standards of excellence. A celebrated artist when asked to name the first essential to success in his profession replied "to see right." So it is in this field; no one ever succeeds without first seeing right. A man can no more attain the highest excellence and skill in agriculture without a clear mental conception of his object than can an artist produce a great masterpiece without a right conception of what constitutes the highest art.

During the closing days of the recent Trans-Mississippi Exposition at Omaha, while the stock show was in progress, a very successful shepherd, a man who was a real artist and a master hand at his profession, showed a sheep from his father's flock in England that was very much admired by all who saw it; a sheep that was a marvel of excellence in all qualities that go to make up a perfect sheep. "Where was that sheep bred?" inquired an interested stockman. "Ah," replied the young man, "that sheep was bred in England before I was born," meaning by the reply that it had taken fifty years of constant, thoughtful, painstaking and intelligent work to bring that animal to its present state of perfection.

Good stock does not come by chance nor by haphazard methods. During the Trans-Mississippi Exposition at Omaha, to which I have referred, a students' live-stock judging contest was held, open to all of the agricultural colleges of the United States. There were seventeen contestants, representing five colleges. Each student was examined thoroughly on two classes of hogs, two of cattle and two of sheep, and one of the exam-

iners in that contest, a man who was himself a practical, experienced stockman, and one of the keenest and most intelligent judges of our country, said that the young men whom he had examined were capable of going into the best herds and flocks of the country and selecting the best animals and giving a sounder and more intelligent reason for sustaining their judgment than nine-tenths of the owners or proprietors of these herds and flocks. You may ask why this was the case and why those boys were able to do such creditable work? I reply that it was simply by reason of thorough study and intelligent methods of investigation, by a careful and critical faculty of observing live-stock which comes from analyzing the merits of animals point by point and considering the reasons and their logical results.

A brief consideration of the qualities of practical excellence in beef cattle may well engage the attention of the breeder and feeder. A topic of this character is too often regarded as of interest only to the professional exhibitor or the lecture-room instructor and student. But every successful breeder must always be a student, for the first essential in successful breeding is a clear conception of what constitutes a good animal and of all the characteristics that go to make up real excellence in a herd. It is said that the late renowned Amos Cruickshank, the founder of the great Scotch tribe of Shorthorns, was often seen by the side of the leading sale rings of Great Britain intently studying every animal that came into the ring, and his minute knowledge of all the animals shown was the marvel of those who chanced to converse with him about them afterwards. While the methods of the justly celebrated Robert Bakewell, the first great improver of live-stock, were largely secret, it is known that he was not only an exceedingly close student of living forms, but that his rooms were also full of models and parts of domestic animals that he had carefully dissected and preserved for future reference. In his work of selection and improvement he imparted to the Leicester sheep such a remarkable aptitude to take on flesh that this quality remains, even to the present day, a charac-

teristic of the breed to a greater degree than of any other long-wooled breeds of England.

This aptitude to take on flesh is of vital importance to the beef producer as well as the breeder of show-ring and sale stock. The show-ring type must necessarily keep close to and be largely governed by the practical demands imposed by the feed yard and the block, else the lessons of the show yard and sale ring are without value, if not positively misleading. No one is more concerned in what constitutes the essential qualities of a good beef animal than the man who breeds and feeds for the block and attempts to meet the conditions imposed by the market; for it must be kept in mind that this is the ultimate end of all beef stock, and the best beef animal is the one that carries to the block the highest excellence and the most profit. This, in a word, is the key-note of the whole problem.

The Beef Type.

There is at the outset a well-defined beef type that admits of less flexibility than is generally supposed. We hear much about the dairy type—and there is a dairy type, fairly clean cut and well defined—but there is also a beef type, more clearly defined and less variable than the dairy type. Common observation and experience confirm this assertion. There are not a few cows of quite positive beef tendencies capable of making very creditable dairy records, and a great many that combine milk and beef to a profitable degree, but a good carcass of beef from a steer of a pronounced dairy type or breed is rarely seen. So clearly and definitely is this beef type established that to depart from it means to sacrifice beef excellence.

The accompanying illustrations (Figs. 1, 2 and 3) pretty accurately represent the ideal beef type. The first is a good reproduction from a photograph of a prize-winning Angus heifer exhibited by Queen Victoria at one of the late Smithfield fat stock shows. The next is a portrait of a high-grade Shorthorn steer, raised as a skim-milk calf at the Iowa Experiment Station He was the best steer in the Chicago yards on a day when there were

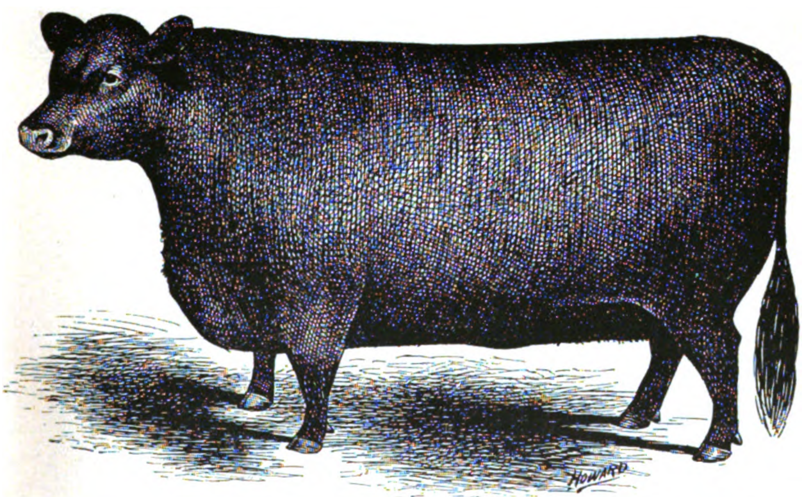


Fig. 1—Champion Angus Heifer, Smithfield (England) Fat Stock Show.

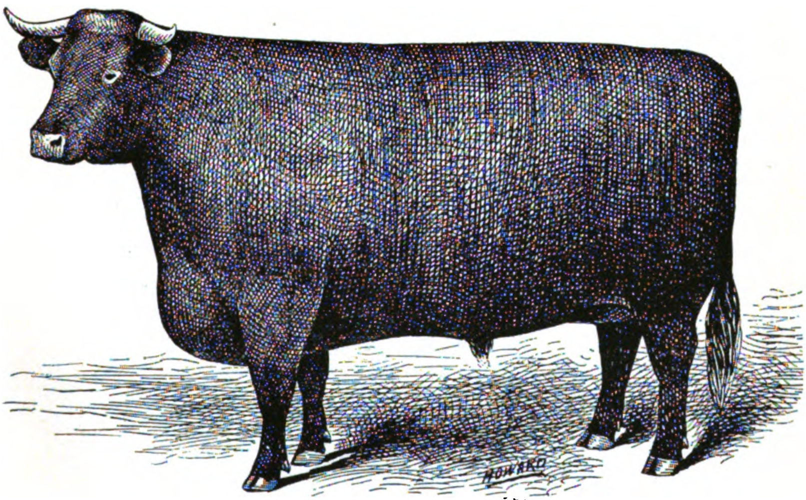


Fig. 2.—High-grade Shorthorn steer.

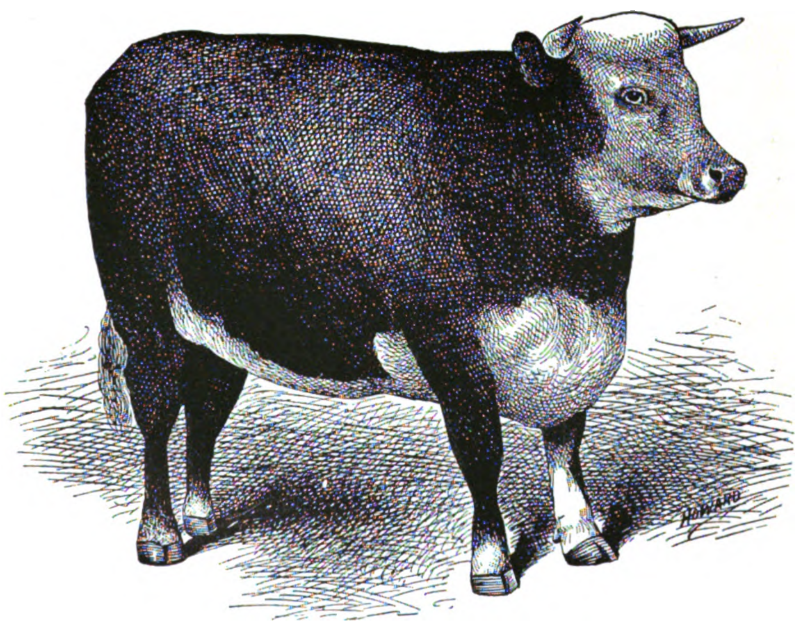


Fig. 3.—High-grade Hereford steer.

26,000 cattle on the market. The third is of a high-grade Hereford steer, fed at the Iowa Experiment Station, that was good enough easily to top the market, and was one of a carload to dress an average of 67.5 per cent. of net beef. He weighed 1620 pounds when two years old.

These animals, though representing different breeds, present that compactness of form, thickness and substance, together with superior finish and quality, coupled with an inherent aptitude to lay on flesh thickly and evenly, that always characterizes the beef animal of outstanding merit.

These points are more specifically itemized in the following score card prepared for the use of students at the Iowa Agricultural College:

Scale of Points.

A. General appearance (25):	Possible score.
Weight, estimated, ——— lb.; actual	..
Form and size, smooth, even, parallel lines, deep, broad, low set	10
Quality, thick covering of firm flesh, mellow touch, soft, heavy coat, fine bone, velvet-like skin	10
Style, vigorous, strong character, active, but not restless	5
*Objections, rough or angular in form, harsh coat, hard skin, dull appearance	..

B. Head and neck (10):	
Muzzle, broad; mouth large, jaws strong, nostrils large	2
Eyes, large, clear, placid	2
Face, short, quiet expression	1
Forehead, broad, full	1
Ears, medium size, fine texture	2
Neck, thick, short and full, throat clean	2
Horns, fine texture, medium size or small	..
*Objections, long or lean head and neck, dull eyes, coarse, heavy horns	..

C. Forequarters (10):	Possible score.
Shoulder, covered with flesh, compact on top, smooth.....	4
Brisket, compact and wide..........................	3
Dewlap, full, skin not too loose and drooping...........	1
Legs, straight, short, arm full, shank fine, smooth........	2
*Objections, bare shoulders, narrow on top, contracted brisket, coarse legs................................	..

D. Body (35):	
Chest, full, deep, wide; girth large, crops full...........	8
Ribs, long, arched, well covered with firm flesh.........	7
Back, broad, straight, smooth and even................	10
Loin, thick, broad, full..............................	6
Flank, full, even with underline, or nearly so............	4
*Objections, narrow or sunken chest, hollow crops, sloping ribs, bare or rough back and loin, high flank..........	..

E. Hindquarters (20):	
Hips, wide, smooth, well covered......................	5
Rump, long, even, wide, smooth, not patchy............	4
Pin bones, wide apart, smooth, not patchy..............	2
Thighs, full, deep and wide...........................	2
Twist, full, deep, large, level with flank or nearly so.....	3
Purse, full, indicating fleshiness......................	2
Legs, straight, short, shank fine, smooth................	2
*Objections, prominent, rough hips, narrow or bare rump, spare thighs, light twist, small purse, coarse legs......	..
Total..	100

The Use of the Score Card.

The score card is an educator and of great advantage to the student, but its use is not generally favored in the show-ring by leading judges. The judge who goes into the show-ring, like the expert buyer in the great markets, should carry a well-defined

*The score card as used in the classes contained an additional column for marking the student's estimate of deficient points.

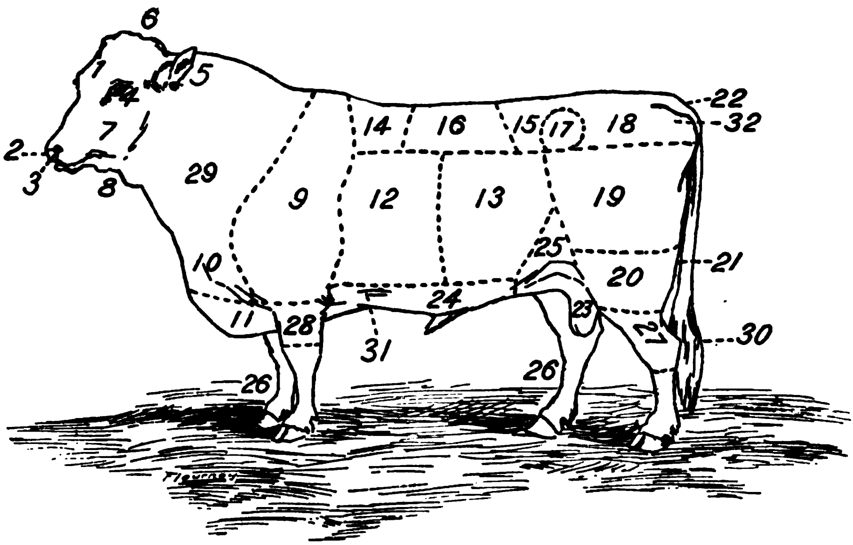


Fig. 4.—Names of points.

1. Forehead and face.
2. Muzzle.
3. Nostrils.
4. Eyes.
5. Ears.
6. Poll.
7. Jaws.
8. Throat.
9. Shoulders.
10. Chest.
11. Brisket.
12. Fore ribs.
13. Back ribs.
14. Crops.
15. Loins.
16. Back.
17. Hooks.
18. Rumps.
19. Hindquarters.
20. Thighs.
21. Twist.
22. Base of tail.
23. Cod purse.
24. Underline.
25. Flanks.
26. Legs and bone.
27. Hocks.
28. Forearms.
29. Neck vein.
30. Bush of tail.
31. Heart girth.
32. Pin bones.

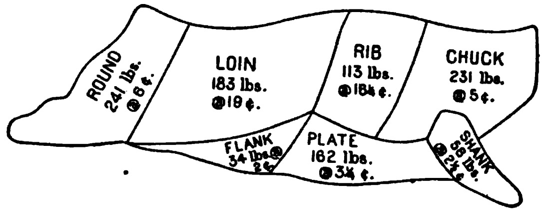


Fig. 5.—Chicago wholesale dealers' method of cutting beef.

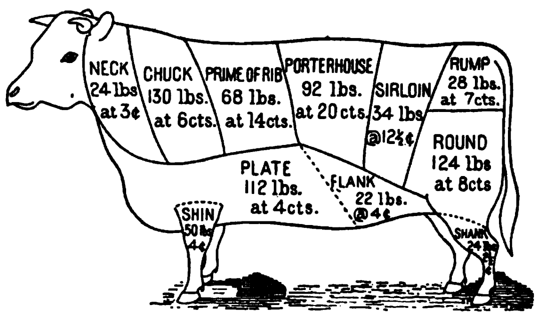


Fig. 6.—Chicago retail dealers' method of cutting beef.

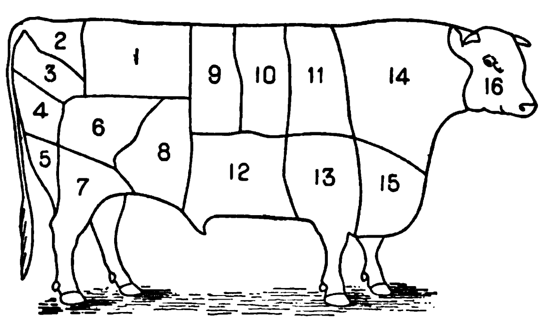


Fig. 7.—English method of cutting beef.

mental conception of a good animal and be able to detect at once the qualities that are objectionable. This applied to the animals of a ring virtually amounts to the use of a score card without the objectionable features of that system. In recommending the score card to the student, the term "student" is used in its broadest sense, embracing not only the prospective breeder within the class room, but every member of the great practical school as well who wishes to keep in the foremost rank of his profession.

It is not necessary here to take up in detail all the points enumerated in the foregoing score card, but it is proper to discuss briefly the controlling principles and logical reasons that govern the formation of a standard of excellence of this nature. The analytical method of resolving every problem into scientific formulas and principles, based on the firm foundation of unquestionable truth, is the intelligent method of study and investigation, and this method ought more generally to prevail in agriculture.

Beef Characteristics Briefly Defined.

The first thing that should be looked to is the general beef form—low, broad, deep, smooth and even, with parallel lines. No wedge shape or sharp protruding spinal column is wanted for the block. Next in importance is a thick even covering of the right kind of meat in the parts that give high-priced cuts. This is a very important factor in beef cattle that is often overlooked. The accompanying illustration (Fig. 5), represents the wholesale method of cutting beef, showing the relative importance and value of the different parts. In a test made in Chicago on six representative beef animals—two Shorthorns, two Angus, and two Herefords—fed and marketed by the Iowa Experiment Station, the cuts designated as "rib" and "loin" averaged 27.8 per cent. of the aggregate weight of the carcass and sold for 63.9 per cent. of the total value. By this method the chuck, or shoulder, and rib cuts are divided between the fifth and sixth ribs, and in doing so the knife is run close up to the shoulder blade. The rib and loin cuts are divided between the twelfth and thirteenth ribs, and the loin is separated from the "round" at the point of the

hip. In cutting for the retail trade the "rib roast" is taken from the cut designated "rib," and the "porterhouse" and "sirloin" cuts are taken from the loin cut. Tenderloin steak is taken from the inside and just beneath the ribs on either side of the spinal column, and the commercial beef tenderloin always comes from inferior stock, mainly from "canners." That class of cattle has no other meat that is desirable for the block, and the tenderloin strips may be pulled out and put on the market, while the remainder goes into the boiling vats for canned or pressed beef. To take tenderloin steak from good carcasses would destroy the value of the "porterhouse" cuts. This the dealer never does. The other retail cuts and their relative values are shown in the second diagram (Fig 6). The third illustration (Fig. 7) represents the retail method of English butchers.

The Chicago and New York markets discriminate more sharply and present a wider variation in the relative price of the prime and coarser cuts than any other markets in the world. By reference to the wholesale method of cutting beef used by Swift & Co., and the actual wholesale selling prices of the several cuts taken from a bunch of cattle sold this firm by the Iowa Experiment Station, it will be seen that the rib and loin cuts command over four times the average price paid for the remainder of the carcass, and it is apparent that the practical beef animal must be good in these parts. Broad, well-covered backs and ribs are absolutely necessary to a good carcass of beef, and no other excellencies, however great, will compensate for the lack of this essential. It is necessary to both breed and feed for thickness in these parts. And mere thickness and substance here are not all. Animals that are soft and patchy, or hard and rolled on the back, are sure to give defective and objectionable carcasses, even though they are thick, and they also cut up with correspondingly greater waste.

A marked and important change has taken place in the profitable type of cattle within comparatively recent years. This change is strikingly illustrated in the development of the Shorthorn. By the courtesy of that veteran feeder and most excellent

authority on live-stock, the late William Watson, I am permitted to furnish a good illustration (Fig. 8) of the popular type of beef animal about the beginning of the present century. At that time Culley said, in one of his contributions on live stock, that the "unimproved" breeds of Teesdale were a "disagreeable kind of cattle, that, though fed ever so long, never produced any fat, either within or without." Youatt, another celebrated author, described them as "generally of great size, thinskinned, sleek-haired, bad in handling, coarse in offal, and of delicate constitution." With this as a foundation stock, it is not so difficult to understand how an animal of the Newbus ox stamp might be classed as belonging to the improved order. This ox was sired by a grandson of Charles Colling's celebrated bull "Old Favorite," and the dam was supposed to be a Scotch Highland cow. The early Shorthorns were large and massive. The famous Durham ox weighed nearly 3800 pounds when 10 years old. The demand for early maturity and plump, sappy carcasses of medium weight and minimum offal and waste had not then set in. It was not until within recent years that the heavy, inordinately fat, or rough and patchy bullock, became unpopular to such an extent as practically to drive this class from the market and to banish the type from the breeding herds. It is well that this was done, for the modern type, represented by the first three illustrations, makes beef at decidedly more profit and economy to both the producer and the butcher and furnishes the consumer a far superior article.

The parts furnishing the high-priced cuts must be thickly and evenly covered with firm yet mellow flesh of uniform good quality and alike free from hard rolls and blubbery patches. Coarse, harsh and gaudy animals will no longer be tolerated, much less those that are bony and bare of flesh on the back and ribs. The men who buy our cattle and fix their market value are shrewd enough to know almost at a glance how much and just what kind of meat a steer or carload of steers will cut out, and if the producer overlooks any of the essential points he is compelled to bear the loss.

Then, in addition to securing the general beef form and make-up, together with good backs, ribs and loins, there is a certain quality, character, style and finish that constitute an important factor in determining the value of beef cattle. One of the first indications of this is to be found in the skin and coat. A good feeding animal should have a soft, mellow touch and a soft but thick and heavy coat. A harsh, unyielding skin is an indication of a sluggish circulation and low digestive powers. The character and finish exemplified by a clear, prominent yet placid eye, clean-cut features, fine horn and clean, firm bone, all go to indicate good feeding quality and a capacity to take on a finish of the highest excellence, and consequently to command top prices. Coarse-boned, rough animals are almost invariably slow feeders and hard to finish properly. A certain amount of size is necessary, but it should be obtained without coarseness. The present demand exacts quality and finish rather than size.

Beside these qualities, and above all, it is necessary to have vigor and constitution. We find evidence of these in a wide forehead, a prominent brisket, broad chest, well-sprung ribs, full heart girth, and general robust appearance; and without these, other excellence will not have its highest significance.

Excellence for the Block Due to Inherited Quality Rather Than Feed or Gain.

The misleading practice of rating beef animals mainly by the gains made in the feed yard is altogether too common. The distinction between cattle of different types is absolutely essential to profitable feeding. There is not a very great difference in the rate of gain, or the number of pounds of increase in weight from a given amount of feed, that will be made by a representative of the best beef breeds, or by a genuine scrub, a Jersey or a Holstein steer. This statement may seem somewhat at variance with prevailing opinion concerning the potency and superiority of improved blood. Practical breeders and improvers of live ..ck have been rather reluctant to recognize this doctrine, and a · n many will not concede it yet, but the evidence is constantly : ·.

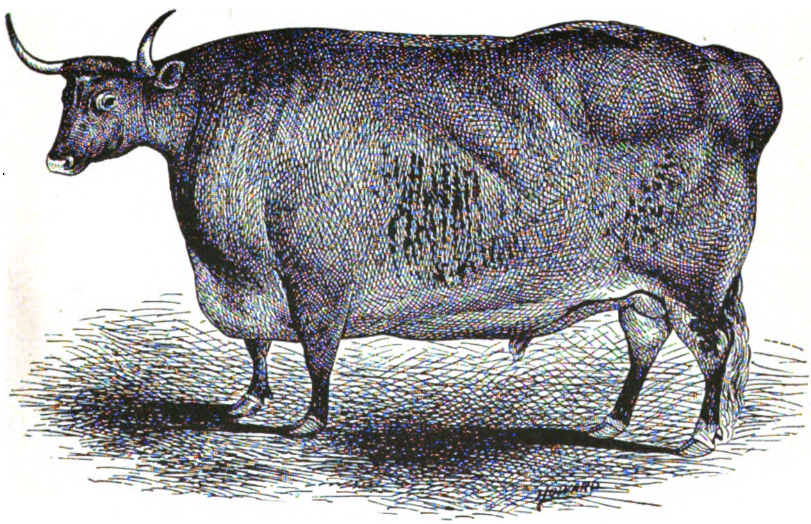


Fig. 8.—Newbus ox.

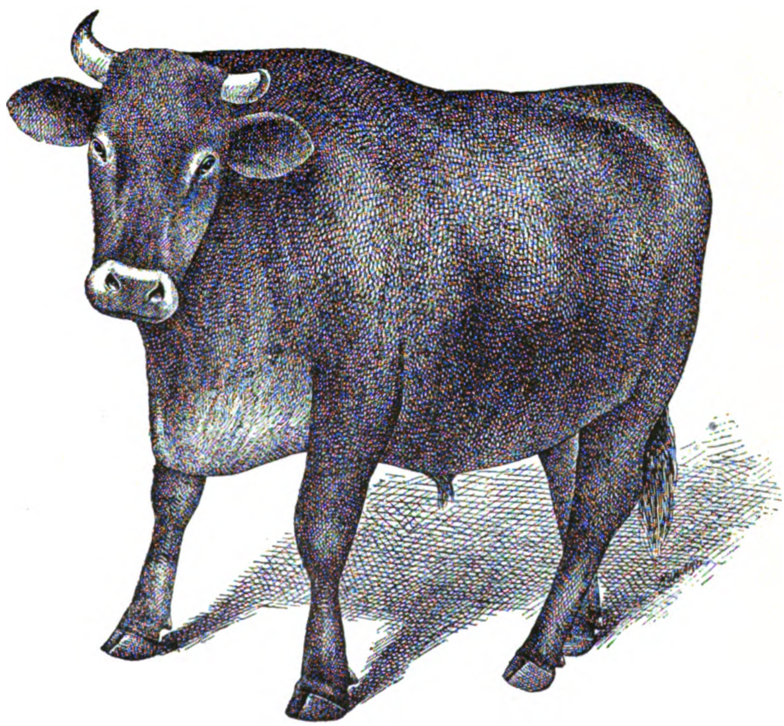


Fig. 9—An unprofitable feeding type.

mulating; the principle has been repeatedly demonstrated, and it is useless to ignore facts.

After all there is no well-founded reason why a Shorthorn, an Angus, or a Hereford should make more gain in weight from a bushel of corn than a native or scrub. This is governed altogether by the digestive and assimilative machinery of the steer. The Holsteins, for instance, are well known to be hardy and extremely vigorous eaters. They consume large quantities of feed, and render good returns for their rations, and the despised scrub has a ravenous appetite, and is almost as omnivorous as a goat. It is not reasonable to expect that the improved breeds, notwithstanding their superiority in other respects, have inherited any greater constitutional vigor or more perfect working organs of digestion than those animals belonging to the class designated as natives, or scrubs, which, from the nature of their surroundings, and the very law of their existence, have been inured to all kinds of hardship. Nature's law of the survival of the fittest was more rigid and exacting than the selection of the average modern breeder. Why, for instance, should a Shorthorn or a Hereford steer be able to utilize a larger proportion of a given ration than a Holstein? Has not the latter been as highly improved, as carefully and as continuously bred for the express purpose of making good return for a liberal ration? Scientists have discovered that civilized man has no greater powers of digestion than the barbarian or the Indian. Neither has the improved steer materially better digestion than the native. The feeder is often deceived in the belief that he has a good bunch of cattle simply because they feed well and gain rapidly. Economy of production is an important factor, but it is by no means all. It is even more important to have a finished product that the market wants and will pay for than it is that it should simply be produced cheaply.

The illustration (Fig. 11) represents a high grade Jersey steer, fed and marketed by the Iowa Agricultural Experiment Station. This steer was fattened and finished for market under conditions quite similar to those of the Shorthorn and Hereford steers previously spoken of, and the rations were practically the same.

The Types Compared.

In making a comparison, only the Hereford will be used, but the distinctions are equally applicable to either. While in the feed lot the Jersey made a gain of 2 pounds a day for nine months and the Hereford 2.03 pounds a day for fourteen months. There was practically no difference in the rate and cost of gain. Judged by the record they made up to the time they went to market, the Jersey would take rank close to the Hereford in both rate and economy of gain. But the interesting part of the comparison came later. The Jersey took on flesh rapidly and was exceedingly fat and well finished. He was as good as it is possible to make a Jersey steer. Yet, when he went to market he had to sell $2.12½ below the top quotations, while the Hereford was one of a carload to sell 10 cents above the top for any other cattle on the market. It is sometimes claimed that this distinction is partly due to prejudice, but since I have followed cattle through the feed lot and to market and onto the block, carefully ascertaining all the facts for several years, I am convinced that the expert buyers who fix the price for beef cattle in the great market centres rate them strictly on their merits, entirely independent of any breed or type consideration. The controlling factor is the utility and inherent value of the animal for the practical test of the butcher. The slaughter and block test clearly revealed the reasons for this marked distinction in the selling value of these two steers.

The Jersey belongs to a breed that has been developed for centuries for the specific purpose of making butter; that is, putting the product of its feed into the milk pail. They are rough, angular and bony, and when fattened they do not put the fat into the tissues of the high-priced cuts of steaks and roasts on their back, as a representative of the beef breed does, but this steer had 190 pounds of what is termed loose, or internal, tallow and 55 pounds of suet on a 763-pound carcass; that is 32.1 per cent. of the steer's carcass was tallow. Tallow was at that time worth 4 cents a pound, while the best loin cuts were worth 19 cents at wholesale. And beside that, this steer only dressed 57.5 per cent. of beef, while the Hereford dressed 67.5 per cent. Then,

the Hereford had only 95 pounds of tallow and 38 pounds of suet on an 888-pound carcass, equivalent to 15 per cent. And beside this striking difference in the percentage of meat in the high-priced cuts, the meat of the Jersey was much inferior to that of the Hereford. The Jersey steer went on accumulating fat around his paunch and internal organs to the extent of nearly one-third of his entire body weight, while he did not have meat enough on his back decently to cover his bones. This explains why a Jersey or a Holstein, or any other animal not expressly bred for beef, can never be made plump and smooth, no matter how long it is fed or how highly it may be fattened. Besides, what scanty flesh that is there will be found of inferior quality owing to the absence of that fat deposited throughout the tissues of the meat that is necessary to a ripe, juicy and highly flavored cut. There is a fundamental and essential reason why rough cattle do not sell. These same distinctions are largely true of the native and all other unimproved cattle when an attempt is made to fatten them for beef. The men who buy them are well aware of these distinctions and they fix their market values accordingly.

It is of vital importance, then, that the feeder should have the right kind of cattle for fattening. The Jersey and the Hereford steers previously referred to made practically the same gains in the feed lot and at substantially the same cost per pound for feed consumed, but the market comparison revealed the fact that the steer of beef type and inherited beef-making capacity was making a product worth 49 per cent. more than the other steer, and this increased value not only applied to the gain made in the feed yard, but to the entire carcass as well. The feeder cannot afford to ignore these distinctions. They are of vital concern and determine profit or loss. If the producer were hauling his corn or other products to market, instead of feeding it to cattle, he would not hesitate to select one that would return 49, or 25, or even 10 per cent. more than another. The loss cannot be afforded in either way.

Growing Potatoes Successfully in New York.

By T. B. Terry.

Farmers who have nearby markets can grow potatoes almost any way and get along. Those who raise this crop to ship to market, or to sell to shippers, have to manage carefully to make anything in the future. The former sell to the consumers, or to the retail grocers. They get almost all there is in the business. The latter have to pay commissions and profits to dealers and freight to railroads. Potatoes are now grown by the hundred acres on a single farm in Aroostook county, Maine, in Michigan, Wisconsin, Minnesota, Kansas, etc., etc. Many of these growers have rich land and great, clean fields, without obstruction. Large shippers get rebates from the railroads, at any rate they can get their potatoes, hundreds of car-loads, moved long distances for very little money comparatively. Machinery is used on these great fields to produce the crop as cheaply as possible. Growers of potatoes for shipping, in New York, have to meet this competition. A few years ago they did not. High freight rates prevented the moving of potatoes long distances. But all this is changed. It will require the best methods in the future to make money growing potatoes, on the average.

Cheap Fertility.

The large growers above named, except in Maine, are not purchasing plant food to any extent. They have enough in their soils, or at least they get along with what they have. Aroostook county, Maine, has used large quantities of fertilizers for potatoes; but the writer was there some years ago, talking to large audiences and telling them they ought to grow clover in regular rotation and reduce the fertilizer bill. Reports from there show they

are working in to this way of producing the crop cheaply. The climate favors these Maine farmers, and many in the other northern States named. It is easy to grow large crops. Fertilizers may pay New York farmers well, but they cost money. To compete with the northern world they must get fertility for less money. They must pay more attention to growing clover and peas in regular rotation with potatoes and other crops. A heavy crop of clover grown once in four years may get hundreds of pounds of nitrogen out of the air and make it available for potatoes, corn, etc., that follow. You cannot afford to pay $15 or $20 a hundred pounds for this when you can manage to get it for nothing. The clover will pump up plant food from the subsoil, also, and leave that available. The big western growers are getting hold of this matter. The writer has talked to many of them in Minnesota, where they are growing clover and increasing their crops; so much the worse for you if you do not do the same.

Many of the northern growers have made the serious mistake of growing potatoes either continuously, or too frequently, on the same land. Do not do this. You will soon have serious trouble from scale, blight, rot, etc., which multiply and increase more rapidly where the crop is continuously grown. And then more plant food must be purchased under this method of management. Do not grow potatoes oftener than once in three years on the same land. The writer has followed for many years a three-year rotation of clover, potatoes and wheat. These were early potatoes, so we were able to get them off in time to put in fall wheat. With late potatoes, oats or spring wheat could be substituted. This rotation is all right for a few years, but a four-year one would be safer in the long run. We have grown clover pretty often; we may have trouble from this. Scientific men think we may. But meanwhile we have made a nice sum of money growing potatoes that feed on the plant food the clover obtained. We have not purchased fertilizers. And still few, probably, have done any better than we have with this crop, and our land was in poor shape to start with.

If you care to grow corn, I advise this rotation: Clover, corn, potatoes and small grain to seed with. Manure the clover sod for

corn. Keep stock enough to eat the clover, and corn, oats and some purchased food, and use the straw for bedding. Save all the manure, liquid and solid; not sort of half way, but actually *all* of it. That is the way we do. Have cement floors under all live-stock, manure shed, etc. These last points are of great importance to you. I'll tell you why. The large western farmer won't get to this point for some years to come. You get right at it and you can increase your crop, in connection with other good methods, so as to compete with him. You may say you can't make the clover grow now. But you must. Where there is a will there is a way. I saw on an old "worn out" (?) farm in Vermont, last summer, as fine clover as ever grew on earth, many acres of it, on the farm of C. F. Smith. This man's neighbors said clover would not grow. Well, Mr. S. made it. You can. With him it came from the use of lime and potash, and an increase of vegetable matter in the soil to decay, and persistent sticking to it. The clover grew better and better each time it came around in the rotation. In the northern part of the State you may grow good feed and increase fertility by raising field peas, in connection with oats, to hold them up. I do not need to tell you that hay made from peas, oats and clover, nicely cured and early cut, is worth nearly as much again per ton as timothy for cows, young growing animals, sheep, etc. You get this in addition to the fertility.

The Best Tillage.

One can hardly expect the western farmer, with his great fields, to be very thorough in his tillage. The tendency there is to get an income from the number of acres, rather than from the yield per acre. Here is a chance for the New York farmer. Till thoroughly from beginning to end. Do the best that is known now along this line. There are probably fifteen or twenty tons of nitrogen, phosphoric acid and potash in one acre of your potato land, within one foot of the surface. But it is locked up by nature and only a very little becomes unlocked and available for crops each year, with ordinary tillage. More tillage of the right kind will make more of it available. This will be particularly true when you supply your soil with plenty of vegetable matter to de-

cay in it by growing heavy crops of clover, manuring, plowing in catch crops, etc. Work the seed bed more. Work it deeply. Work it roughly, that is, throw it around a good deal and mix it up. Make it fine, where it is clayey enough to form lumps. Do all working when it is rather dry. Cultivate the crop many times; keep stirring the ground, as long as you can get a horse through it. Go as deeply as you can for a week or ten days after you can see the rows, and then after that never more than two inches deep. Before your potatoes (and corn) are six inches high the roots come together between the rows. If you tear any of them off, as you will if you go more than two inches deep, the plants must grow them over again. In a dry time this means serious loss, in particular. You do not need to stop this kind of culture at blossoming time; it can do no harm and usually will do much good. Look on the potato field as a summer fellow that you will work about all summer, and grow potatoes while you are doing it. You may make much plant food available in this way, not only for the potatoes but for other crops following.

In the spring there is usually plenty of water in the soil and subsoil. If you do not do your part a good proportion of this may be taken up into the air by sun and wind, and wasted. Two inches of freshly-stirred, fine soil makes almost as good mulch as a foot of straw. Keep this earth mulch present from the moment the ground is dry enough to harrow, in the spring, until the potato crop is grown, as nearly as is practical. In connection with the vegetable matter mentioned above in the soil, to hold water, your tillage may make you a fair crop, almost without regard to rainfall. In stirring the ground to make more plant food available, do the work also at just the right time to form a mulch and check evaporation. Never let the surface dry up hard after a rain. You can use a smoothing harrow until the crop gets up; then a weeder is better, after the tops are too large for the weeder, and also in connection with weeder use one-horse cultivators, with many small teeth. We have planted four inches deep and then did not hill up any, at least not more than an inch or two. Some earth will be thrown to the rows. Remember that weeds take a great quantity of water out of the soil. To grow a ton of

dried weeds on an acre would mean the loss by evaporation through the leaves into the air of some 300 to 400 tons of water. Often the potatoes seriously need the water. Don't let the weeds use it up. Keep the surface so constantly stirred with smoothing harrow, weeder and cultivator that no weeds practically can ever see day light; then they will be killed as they sprout in the soil.

Do you think the large western grower will give careful attention to all these points? Well, I am afraid not, usually. It is a grand chance for you to get ahead of him. Till thoroughly to help feed your crop, and to water it. This is no idle tale; no theory. The writer has made thousands and thousands of dollars by putting into practice for many years all that is written here. He has grown large crops without fertilizer, over and over again. He has grown large crops ($100 to $160 per acre), almost without rain, right in the midst of failure. In the worst seasons he has cleared a hundred dollars an acre on potatoes over all cost, and furnished neighbors with what they wanted to eat, although they planted in the spring, and on just such land as his. Man can do almost anything, and he believes in doing it and making success come.

Other Pointers Briefly Outlined.

Above you have a foundation that is solid and good. One can not enter into the small details of the business in a brief article like this. It would require a book. But I will try to give you a few important pointers. The western man drives about five horses, that draw a wide disk harrow, and leads three more that are following with a smoothing harrow, across his long fields. Change your fields so as to make them as long as you can and get large tools and drive more than two horses. If you are going to grow potatoes to sell to shippers, or to ship yourself, grow enough to amount to something; enough so that you can afford the best labor-saving tools on the market. The Robins planter is the best one made. The Hoover digger is almost perfect, under any reasonable circumstances. I say this after riding on it many seasons. We use four horses to draw it. Of course being all iron it is not fit to dig soft, green potatoes. We have found it well

to use potato boxes for handling the crop, by the hundred. They are 16x13x13 inches inside, with hand holes in the ends and made of very light wood. They hold one bushel (60 pounds) even full; thus one can be placed on another.

Find out what varieties of potatoes do best on your soil and in your climate and then stick to them as long as they do well, and select the best for seed each year. Don't grow more than one or two kinds. Straight goods sell far better than mixed. Keep your seed so that no sprouts will start until after the potatoes are in the ground, for main crop. The first sprout gives the strongest plant. You can sprout a few in the light for early ones. Do not apply fresh manure on land for potatoes. Put it on at least the fall before hand.

In the four-year rotation named (clover, corn, potatoes and small grain), the manure applied to the clover sod for corn will be in excellent condition for the potatoes the following year. Treat all seed to destroy scab germs that may be on it, thus holding this trouble in check as far as you can. If you grow potatoes with nearly level culture (always the best way in a dry season, and as good in a wet one on drained land), plant in drills. If you plant in hills, you must hill up or they will grow out of ground and crack ground open and be injured in quality. If you want potatoes perfect in quality (snowy white inside), never let them be exposed to any light at all from the time they set until you eat them, so far as is possible. Keep them where it is absolutely dark. Those who sell to consumers or to local retail dealers may well make a note of this point; and also it will pay them to grow only those varieties that are choice to eat. Much of our money was made in this way. I have sold 1,000 bushels of potatoes to a grocer in the city at one time for 15 cents a bushel above market price. First, I produced something choice, way above the ordinary, and then I let folks know what I had. After trying them and finding that they could depend on their being No. 1, always, they readily paid me my price.

Fertilizing Self-Sterile Grapes.

By. Prof. S. A. BEACH.

Not long ago a letter was received at the Geneva Experiment Station from a grape grower near Seneca Lake, in which the writer says:

"I have some Wyomings and they don't bear well, and I have been grafting some of them with other varieties. They make good, strong, healthy stock to graft on. I want to get a few of some good early varieties. Is the Croton a good bearer? Does it cluster well? Do you know anything of the Alexander Winter, its color, quality or any other particulars?"

Such inquiries serve as a very good introduction to the subject—"Fertilizing Self-Sterile Grapes."

Similar questions in one form or another may rise in any community where American grapes are cultivated. Although they may vary in detail, sometimes one variety causing disappointment and sometimes another, they are frequently similar in their primary significance in that the fundamental cause of their trouble lies in the inability of the variety properly to fertilize itself. Such is the case with the Wyoming, which this correspondent is grafting over to other kinds. The Wyoming usually fails to set any fruit, unless it is fertilized by some other variety, as does also the Alexander Winter referred to. These are in this particular, representative of a large class of American grapes, many of which rank very high in flavor and quality, and when well-formed clusters can be produced are remarkably attractive in appearance, but unable to fertilize themselves they are unreliable croppers, unless cross-fertilized with some other variety. The Croton, to which our correspondent refers, on the other hand, produces well-filled clusters without the aid of any other variety. In this respect it is representative of another large class, including many of the varieties which have proved most generally successful in commercial vineyards.

A year ago the State Agricultural Experiment Station at Geneva, N. Y., published Bulletin No. 157 on the "Self-fertility of the Grape," in which each of the 169 cultivated American varieties was classified according to its ability to set fruit of itself. The following pages from this bulletin contain the classified lists just mentioned:

In this classification the varieties are arranged in four classes, according to the average character of the clusters which have developed from covered blossoms on vines in apparently normal condition. In cases where there is doubt as to whether the vine was in proper condition for the test the name is followed by a question mark, to indicate that the classification is doubtful.

Class 1 includes varieties which when self-fertilized have formed none but perfect clusters, and those with which the clusters have varied from perfect to somewhat loose.

Class 2 includes varieties which when self-fertilized have on the average formed marketable, although not compact, clusters.

Class 3 includes varieties which when self-fertilized have on the average produced clusters too loose to be marketable. This class has a wide range. It extends from the varieties in Class 2, with clusters not too loose to be marketable, to Class 4 which includes the self-sterile sorts. There are varieties in this class which have on the average produced self-fertilized clusters nearly compact enough to be marketable, some being compact but others being loose. At the lower limits of the class are found varieties which usually fail to produce fruit on covered clusters but, which have occasionally borne a few scattering fruits when the clusters are covered.

Class 4 includes those varieties which have not produced any fruit on covered clusters.

Classification According to Self-Fertility.*

CLASS 1.—CLUSTERS PERFECT OR VARYING FROM PERFECT TO SOMEWHAT LOOSE.

Ambrosia,	Hopkins,	Niagara,†
Antoinette,	Janesville,	Opal,
Berckmans,	Lady Washington,	Poughkeepsie,
Bertha,	Leavenworth,	Pockington,
Columbian Imperial,	Lucile,	Profitable,
Cottage,	Lutie,†	Prentiss,
Croton,	Mabel,	Rochester,
Delaware,†	Marvin Seedling White,	Rutland,
Diamond,	Mary Favorite,	Senasqua,
Diana,	Mathilde,	Shelby,
Early Golden,	Metternich,	Telegraph,
Etta,	Monroe,	Winchell,†
Herald,	Moore's Early,	Worden.†

*This clasification is here modified to include the changes which are necessitated by the investigations of 1899.

†Previous records confirmed by 1899 tests.

CLASS 2.—CLUSTERS MARKETABLE; MODERATELY COMPACT OR LOOSE.

Agawam,
Alice,
Arkansaw,
Bailey,
Big B. Con.,
Big Extra,
Brilliant,
Brown,
Burrows No. 42a.,
Carman,
Catawba,§
Caywood No. 50,
Centennial,
Champion (Cortland),
Chandler,
Chautauqua,
Clinton,
Colerain,
Concord,
Dr. Collier,
Duchess,
Early Market,
Early Ohio,
Early Victor,
Edmeston No. 1,
Elsinburg,
Elvira,
Empire State,
Esther,
Fern Munson,
Glenfeld,
Golden Grain,
Hartford,
Highland,
Hopican,
Illinois City,
Iona,
Isabella,
Isabella Seedling,
Jefferson,
Jessica,
Lady,
Leader,
Lindmar,
Little Blue,
Livingston,
Marie Louise,
Mills,
Missouri Riesling,
Nectar,‡
Norfolk,
Olita,
Paradox,
Paragon,
Perkins,
Rockwood,
Roger's No. 13,
Roger's No. 24,
Roger's No. 32,
Rommel,
Shull No. 2,
Standard,
Triumph,
Ulster,
Victoria,
Wheaton,
Witt.

CLASS 3.—CLUSTERS UNMARKETABLE.*

Adirondack,
Alexander Winter,
Amber Queen,
Aminia,
Beagle,
Big Hope,
Brighton,
Canada,
Canonicus,
Daisy,
Denison,
Dracut Amber,
Eaton,
Eumelan,
Geneva,
Gold Dust,
Hayes,
Hercules,
Lindley,
Marion,
Noah,
Northern Muscadine, (?)
Norwood,
Pearl,
Roenbeck,
Ross (Gov.),†
Thompson No. 5,
Thompson No. 7,
Vergennes,
Woodruff,
Wyoming.

CLASS 4.—SELF-STERILE; NO FRUIT DEVELOPS ON COVERED CLUSTERS.*

Aleda,
Amber, (?)
America,
Barry,
Black Eagle,
Blanco,
Burnet,
Clevener,
Creveling,
Dr. Hexamer,
Eldorado,
Elvibach,
Essex,
Faith, (?)
Gaertner,
Grein Golden,
Herbert,§
Jewel,
Juno,
Massasoit,
Maxatawney, (?)
Merrimack,§
Montefiore,
Oneida,
Red Bird,
Red Eagle,
Requa,
Rogers No. 5,
Roscoe,
Rustler,
Salem,
White Jewel.

*In cases where the vines were not in good condition throughout the test the classification is marked questionable.

†Further testing may show that Governor Ross belongs to class 2.

‡Three self-fertilized clusters in 1899 averaged 90 on scale of 100.

§See pointer above.

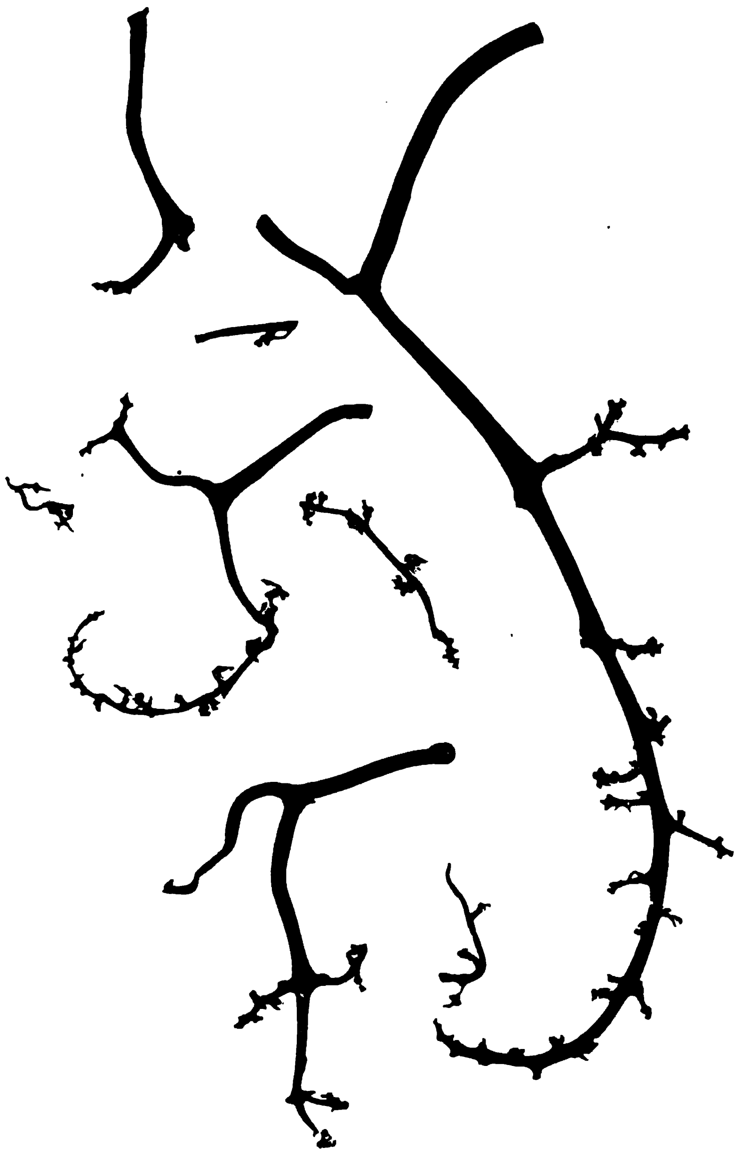


Plate I—Eumelan self-fertilized.

Plate II—Brighton self-fertilized.

Plate III—Brighton open to cross-fertilization.

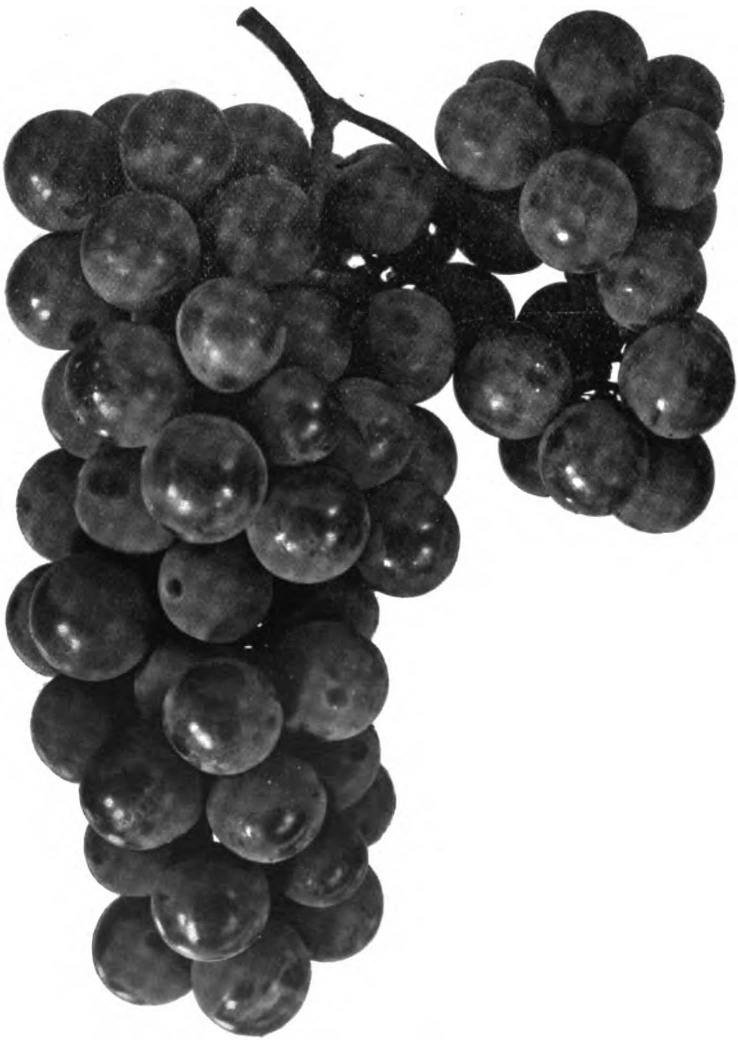


Plate IV—Diamond self-fertilized.

Plate V—Duchess self-fertilized.

Plate VI—Herbert.

Plate VII—Barry.

Varieties Which Should Not Be Planted Alone.

These investigations have a practical bearing both on the selection of varieties and on their arrangement when planted. The self-sterile kinds cannot be expected to set fruit when they stand alone. Plate 1 shows what was left of covered Eumelan clusters at the time the fruit ripened on the uncovered clusters. It is seen that not a fruit developed when the Eumelan was compelled to depend on itself for setting fruit. Herbert and Barry likewise fail to fruit when dependent on their own blossoms for pollination. Brighton does a little better. The best results which its covered clusters gave in these investigations are the three clusters shown in Plate II. But self-sterile varieties may produce well-formed clusters when located near enough to other kinds of grapes so that cross pollination can occur. The clusters of Herbert and Barry, shown in Plates VI and VII, and that of Brighton, shown in Plate III, were borne on vines which were located favorably for cross pollination.

The varieties which are listed in Class 3 have generally developed clusters imperfectly filled and unmarketable and those named in Class 4 have failed to develop any fruit whenever cross pollination has been prevented. If these varieties are planted at all they should be set close to other varieties, which bloom at the same time, so as to provide for cross pollination.

The varieties which are named in Classes 1 and 2 produce well-formed clusters of themselves. The covered clusters of Duchess and Diamond, illustrated in Plates IV and V, show what perfect clusters may develop on varieties in these classes when the blossoms are self-pollinated. The varieties named in Classes 1 and 2 may therefore be planted alone without reference to cross pollination.

Explanation of Plates.

Plate I. Eumelan self-fertilized.
Plate II. Brighton self-fertilized.
Plate III. Brighton open to cross pollination (reduced one-third).
Plate IV. Diamond self-fertilized (reduced one-third).
Plate V. Duchess self-fertilized (reduced nearly one-third).
Plate VI. Herbert (reduced nearly one-half).
Plate VII. Barry (reduced nearly one-half).

After Bulletin 157 was issued, inquiries came to the station from various sources, bringing up the question whether one kind of grape was any better fertilizer for the self-sterile kinds than another, or whether all that was necessary to provide for the proper fertilizing of a self-sterile kind was simply to plant next to it a variety which came into bloom with it. For the purpose

of gaining some information on this subject investigations were begun which, in 1899, included tests in fertilizing 12 nearly or quite self-sterile kinds with pollen of various varieties, some of which were self-sterile.

Methods of Making Tests.

All clusters were covered with bags before the blossoms opened, to keep away the insects, which might otherwise visit the flowers and bring with them the pollen of other varieties. This was done with the clusters which were to receive the pollen and with those which were to furnish the pollen also. When the clusters were in bloom the bags were opened and the blossoms brushed with clusters taken from the variety which had been chosen to furnish the pollen for that particular test. The bag was then immediately closed and properly labeled. It was left undisturbed till after the vines had gone out of bloom, after which the results of the tests were recorded. When the fruit was ripe it was gathered and each cluster rated on the scale of 100, to show how well filled it was with fruit, 100 representing a perfectly formed cluster.

Some of the results are summarized briefly in the following paragraphs:

Aminia is practically self-sterile. When it was used to pollinate Brighton the clusters averaged 0.3 on a scale of 100 for a perfect cluster. When used to pollinate Wyoming the average rating was 2. This indicates that Aminia is practically worthless as a fertilizer for self-sterile sorts. When Brighton and Wyoming were pollinated with strongly self-fertile kinds like Catawba and Niagara, good clusters of fruit were produced. Black Eagle, as far as tested, has proved self-sterile. It was used to pollinate the self-sterile Barry and the practically self-sterile Eumelan, but no fruit resulted. Brighton is practically self-sterile, but occasionally it produces a few fruits when self-pollinated. (See Plate II.) It was used to pollinate the following varieties which are self-sterile, or nearly so (the average

rating in each case follows the name of the variety): Aminia, 1.7; Black Eagle, 0; Eldorado, 0; Herbert, 0; Lindley, 4; Merrimack, 8.8; Salem, 0; Wyoming, 12. Catawba has proved to be strongly self-fertile in the tests of its self-fertility which I have made. It was used to pollinate the following varieties, which are self-sterile or nearly so (the average rating follows the name of the variety): Aminia, 89; Brighton, 74.4 and 80; Eldorado, 0.5; Herbert, 100; Lindley, 63; Merrimack, 91.7; Salem, 4; Wyoming, 100. Herbert is self-sterile. When it was used to pollinate the self-sterile Eldorado and Salem, no fruit was produced. When used on the nearly self-sterile Brighton the average rating was 28. Lindley, so far as tested, has proved self-sterile. It was used to pollinate the following kinds, which are self-sterile, or nearly so (the average rating in each case following the name): Brighton, 2; Eldorado, 0; Herbert, 0; Merrimack, 32; Salem, 0.4. Merrimack is self-sterile. When used to pollinate the self-sterile Lindley, Herbert and Salem, no fruit resulted. When used on the partly self-sterile Brighton, all clusters but one failed to fruit, and that was well filled. This test should be verified by further work. Niagara is strongly self-sterile. It was used to pollinate the following varieties, which are self-sterile, or nearly so (the average rating after each name): Aminia, 80; Brighton, 85.7 and 52.5; Eldorado, 76; Herbert, 98.8; Lindley, 77; Merrimack, 96.3; Salem, 98.

Without giving further particulars, it will be sufficient to say that without other tests which were made the results in general were similar to those which have been given. The use of self-sterile, or practically self-sterile, grapes for fertilizers for other self-sterile, or nearly self-sterile kinds, resulted in failure. When varieties which are strongly self-sterile, like Catawba, Niagara and Worden, were used to pollinate these self-sterile sorts, generally good clusters of grapes resulted.

In conclusion, a word of caution as to the significance of the average ratings which have been given in the above account of these investigations. They cannot be taken as showing accurately the ability of the variety to fertilize the other varieties upon which

its pollen was tried, because the clusters were not always in full bloom when pollinating was done. Nevertheless, in a general way, the results may be taken as signifying that self-sterile sorts are practically worthless as fertilizers for other self-sterile varieties, and that it is best to select as fertilizers for self-sterile grapes strongly self-fertile kinds which bloom at the right season. For a more complete account of these investigations consult Bulletin 169 of the State Experiment Station, Geneva, N. Y.

Some Practical Points in Bean-Growing.

By J. E. Wilson, Linwood, N. Y.

Beans seem more particular in requirements of soil and climate than most farm crops. The area devoted to cultivation is quite limited, western New York and Michigan furnishing the greater part of the domestic crop. Their cultivation has necessarily been developed in the field by practical experience, and methods here outlined are employed by our most successful bean-growers. Beans do best on rather heavy soil if well drained, naturally or otherwise. They are very sensitive to an excess of water in the ground. Good corn land will grow good beans, generally. They will not thrive on light or sandy soils unless well manured. A clover sod makes the best seed bed. A corn stubble manured the year previous for corn, or an old sod, fall plowed, will give good results. They pay well for stable manure, especially if applied the fall or winter before on sod. Plow the ground in spring as soon as dry enough to work mellow, usually the early part of May with us, plowing deep, eight to ten inches, if the soil will admit of it, and do a thorough job, as careless plowing will materially reduce yield. As soon as plowed, ground is rolled and thoroughly fitted, and then worked over about once a week until planting time. It should be cultivated twice or more, during this time, with a large-toothed cultivator, working it from four to six inches deep. This deep working by large-toothed implements, thoroughly stirring the soil and bringing new particles together, seems to bring about some chemical action, which, while it may not be understood, has proved beneficial. If it is a dry spring, only shallow working should be given for a few days previous to planting, that the moisture may rise near

enough the surface to germinate seed. This thorough working for a month or six weeks will make a mellow and moderately firm seed bed to the depth of four or five inches, will liberate a large amount of plant food and destroy most of the weed seed.

The time of planting will depend somewhat on the variety grown. The Marrow pea, perhaps more largely grown than any other, is planted anywhere from May 25th to June 20th, usually about June 10th or 12th. The Marrow, Yellow Eye, Red Kidney and others of the larger varieties, are planted a week or ten days earlier. About three pecks of pea beans, and from four to five pecks of the large varieties, per acre are planted in drills twenty-eight inches apart. Most growers use common grain drills for this purpose, stopping the hoes not needed. Care must be taken not to get the seed too deep; if the ground is in good condition, one inch is plenty deep. If they do not come up quickly they will not make a full crop. If your soil responds to fertilizers, an application of from 100 to 250 pound of a mineral fertilizer will increase the yield and help ripen the crop evenly and earlier—two important points.

A few days after planting, and before beans come up, go over ground with weeder. This breaks all crust, destroys what weeds may have sprouted and levels ground, so that crop can be cultivated sooner. Just as soon as they are large enough, the cultivator and weeder is started, cutting as close to the row as possible, the first time with the cultivator. The weeder is used in connection with the cultivator as long as practicable, going over the beans once a week or every ten days until ripe, or until vines fill the row. After first time over, cultivation should not be over an inch or inch and a half deep and ground kept as near level as possible. With proper points for the cultivator this can be very easily done.

In raising a crop of beans it must be borne in mind that they make their entire growth in about three months, and that in the dryest and hottest part of the year, and in ordinary seasons, a large part of the moisture which they need will have to be held in the ground from the spring rain. Hence, the necessity of early

and deep plowing and the thorough preparation of the soil before planting, as a deep, thoroughly-prepared soil will hold more moisture than a shallow and cloddy one. Frequent cultivating breaks any crust and checks evaporation, leaving most of the moisture for the use of the plant. In plowing deep and cultivating shallow you give the largest amount of root room for the plant, giving them every chance to produce a full crop.

As soon as pods are ripe, and before dry enough to shell, they are harvested by a machine made especially for this purpose. Two knives, running about an inch below the surface, pull the beans by the roots, two rows at a time, the knives set at proper angle, to bring rows together. They are then thrown into bunches with forks to cure, two or three of the double rows being thrown into one, leaving room to drive a wagon to haul to barn. They are mostly threshed by a machine built for the purpose, somewhat similar to our grain threshers and requiring the same power to run it. Where only small lots are raised, they are often tread out on the barn floor by horses, in frosty weather. Produce dealers take them as they come from the machine and run them through screens, after which they are picked over by hand, and stones, earth and damaged beans removed. Dealers buy them by the bushel (62 pounds) and deduct five cents for each pound wasted in picking. This is often a serious shrinkage to the grower. The price paid here (Linwood, N. Y.) for hand-picked beans is about 35 cents below New York quotations.

Beans grown as above outlined, on soil adapted to them, in a favorable year ought to make a crop of 18 to 20 bushels per acre, although this is considerably above average. They pay as well, perhaps, on an average as other common farm crops. The fodder makes excellent feed for live-stock; sheep, especially, are very fond of it and will thrive better on it than on hay.

Twelve Years' Experience in Spraying.

By EDWARD VAN ALSTYNE, Kinderhook, N. Y.

The question is often asked, "What is the use of all this spraying?" Is it necessary? A few years ago we heard nothing of these various insects and diseases. Is it a notion gotten up by the people who have something to sell, makers of spraying apparatus or dealers in chemicals? Are these new troubles? I answer by saying that most of these troubles are not new. We have been increasing our plantings of fruit trees and plants, and have thus furnished excellent food, as well as good breeding ground, for various pests, something more suited to their needs, as well as more plentiful than the wild plants, on which they originally subsisted. Fruit plantations multiply; so do these troubles. As we increase traffic with the whole world we continue to bring in new pests and diseases. Dr. Howard says that of the 75 insects most injurious to fruits, 37 are of foreign origin. Cold, hard facts, but we may as well accept them first as last. He who will not adapt himself to these changed conditions will surely be left in the rear of the procession of progressive fruit-growers. The man who will control conditions is the man who will be paid for fruit-growing as never before.

I do not entertain the foolish idea that spraying is the only thing necessary to make fruit-growing successful. Spraying will not fertilize or cultivate the soil, or prune trees. You have commenced at the wrong end if you think spraying is all that is necessary. If I must choose between spraying, fertilizing and cultivating, I shall abandon spraying, and cultivate and fertilize. If growers think they can starve trees by lack of fertility and cultivation, and once in three or four years cut out the summer's firewood from the trees, and call it pruning, and then go to work and spray

and expect satisfactory results, they will be sadly disappointed, and, as many have done before, condemn spraying. After we have fertilized, cultivated and pruned, if we want perfect fruit and greatest success, we must spray, and spray thoroughly and intelligently. I want to emphasize the foregoing facts. Twelve years ago I was convinced, after giving my orchard the best care that I could, that insects and disease were increasing, and when first I heard spraying talked of, I thought it, as many have since, a great disaster, and felt that I might as well quit the business first as last. In the fall of 1886 I sold my winter apples for $2.25 per barrel, net, for first-class fruit. After careful picking and grading we had 100 barrels of rejected apples on account of worms and scab. There were about 25 barrels of windfalls beside, out of 300 barrels shipped to market. If they had been perfect they would have brought over $250, and they were worth $25 or $30 for cider. I reasoned that if spraying would do what people said it would, it was certainly a good thing for me to try. I found that it would not only keep fruit free from worms and scab, but would greatly lessen the number of windfalls. The first year's spraying is often disappointing. Many start in to spray with very little knowledge of what they are spraying for, or how to do the work. They do not do the work at the right time, nor thoroughly, and they are fighting insects and diseases that are well established; hence failure to accomplish what was expected. Diseases and insects multiply year after year, and we certainly cannot expect to destroy them by one year's work. Insects do not start out to commit suicide for our benefit, and will not eat the poisoned leaves if they can get those that are free from it. Therefore, all the foliage must be covered and kept so, if we expect good results. The man who gets best results from spraying is the one who sprays annually, at the right time and for a definite purpose, covering the whole tree with the mixture. I would not spray a tree that had no fruit on it as many times as one that was bearing, but I would spray it once or more, for insect and disease germs are there and must be held in check, less they multiply.

The man who sprays as indicated need fear no new leaf-eating insects or disease that Bordeaux will prevent. I asked a friend of mine in Orleans county if he did not dread the canker-worm getting into his orchard, as it was all through the orchards in that section. I have heard Prof. Bailey say that he could actually hear them eat. He replied: "My trees are annually covered with poison, and I have no fear of the canker-worm." That was several years ago, and his orchard is as free from canker-worms as it was then. I have seen the time when we took 47 large nests of the tent caterpillar from a single tree. For five years I have not had to remove a nest from my large orchards where we have sprayed, while a young one not in bearing and never sprayed we had to go through twice last summer and remove the nests by hand. Why? Because a thorough system of spraying had held them in check and destroyed them.

Spraying is working by faith, which is a great deal harder than working by sight. Here is a little fungus, or insect, so small that few here have ever seen it. We have to take some one's word for what it is, where it is, and what will destroy it. To him who has never sprayed I say, don't do it unless you are thoroughly persuaded in your own mind that it is the proper thing to do. Then know what particular object you are going to spray, the life-history of the insect, or nature of the disease, with what or how can you prevent or destroy it. I believe that only to the man who so acts will success in this direction come.

To illustrate, take the scab fungi. One scientific man says that they are so small they cannot be seen with the naked eye, but are present in our orchards in a latent state, ready to develop under favorable conditions, such as high temperature and moist atmosphere, during which they spread and multiply with enormous rapidity. Bordeaux mixture applied over the whole tree will prevent their spread, as the fungi cannot live when they come in contact with the mixture. This means the trunk, limbs, twigs, leaves and fruit. Simply to throw a little combination of water, vitriol, lime and poison at the tree after the fungus has spread, will do but little good, while properly made and applied it will not only

give us clean, bright fruit, but a vigorous growth of healthy foliage, which means more fruit, a stronger tree and fruit that will keep much longer than that from a tree with poor foliage. This I have found more than once.

After years of experience with the Bordeaux mixture I have come to regard it almost with veneration, and had I to choose between it and insecticides I should without hesitation select Bordeaux. Its value depends largely on its being properly made. Dr. Sturgis has given us much valuable information along this line, and I would advise a study of the bulletin on this subject issued by the Vermont Experiment Station. I have not time to go into detail, only to say that by putting six pounds of vitriol with half of 50 gallons of water, and four pounds of lime with the other half, and then combining these two weak solutions, will give a mixture that will stay in suspension and not clog the muzzle and will spread easily and remain long on the trees. We always dissolve the vitriol and lime before hand, using as many gallons of water as we have pounds of material. A gallon then represents a pound and all figuring is done away with.

The insect that causes the most trouble is probably the codling moth, and while the egg may hatch anywhere on the fruit, it usually enters from the blossom end. If we spray just after the blossoms fall and the fruit stands upright the poison will be collected on the tops at the blossom end, is likely to be retained there for a long time, and pretty sure to be fatal to the worm before it enters the apple. This period when the apple is in this position with the petals open, may be longer or shorter according to the season, and varies with different varieties. It will be readily seen that each of us must watch his own orchard and the different varieties therein to know the proper time to apply the poison to get the most benefit.

There is a prevailing notion that the tree can be best sprayed when it is in full blossom. From the above it should be evident how false this is. Certainly nothing can be gained and much lost by spraying at this time. In addition, it will poison the bees, so necessary for proper pollen distribution. No one has any more

right to destroy his neighbor's bees than his cattle. Instances are on record of the bees carrying the poison into the hives.

Do not think that I consider spraying an easy job. There is nothing connected with fruit-growing I dislike so much. When I have reached the end of the spraying season and put away the sprayer, I always feel like singing a Glory Halleluiah. It is not an easy thing to do, but it pays, and that is what we grow fruit for. We want profit as well as fun.

"How many times and when do you spray your apple trees?" Usually three times. First, just as the foliage starts, using Bordeaux and Paris green. I find this just as good as to spray earlier. Then after the blossoms fall, as noted above, and usually once more, about two weeks later, using Borbeaux and Paris green twice each. Last year I did not spray but twice. It was a dry season and the spray was retained on the trees, having little rain to wash it off. I have Bordeaux on my trees now (February) that was put on last May. Then, too, we had but little weather to develop fungi. Some years it may be necessary to spray four or five times. I use with Bordeaux mixture, half a pound of green or poison to 50 gallons of water; that is for apples and pears. With a good agitator I have never had it burn the foliage. It will take as much as this to kill the bud-moth and will kill tent caterpillars and other insects quicker, which is an item when a rain follows shortly after spraying.

I believe green arsenoid just as valuable as Paris green, and certainly much cheaper. It could be bought last season for 14 cents per pound. For those who are doing much work, white arsenic will be found cheaper still. This needs to be boiled with sal-soda, and while not a difficult job, a beginner had better use the green, as the simpler he can make the operation the better.

I find a good deal of the first spraying can be done best from the center of the trees. This I learned from spraying large elms for the elm-leaf nets. We put a pair of telegraph lineman's spurs on a man and sent him into a 50 or 60 foot tree with 40 feet of hose and 8 foot rod. Ordinarily a good, powerful hand pump, with a good agitator, will do the most practical and thorough

work. Half-way spraying leaves plenty of uncovered foliage and fruit for insects and fungi to feed on. When the work is thoroughly done there is no choice for the insect but to eat and die. From 85 to 90 per cent. of fruit may be made absolutely perfect if the work is properly done.

To show the advantages brought about by the Bordeaux in giving vigorous foliage, I will site you an instance that happened a few years ago. My men ran out of Bordeaux in spraying the Greening trees, and as they were only short half a barrel, I told them to finish with green and water. The next spraying I helped to do myself, and came first to the side of the Greenings that the men had sprayed last. I at once noticed that the foliage was yellow and sickly looking, and as I had forgotten about the lack of Bordeaux I was planning to give them some increased fertility, but on coming back to the other side found the foliage as healthy as any in the orchard. Then I remembered that those were the trees, one side of which had no Bordeaux, showing the value of the Bordeaux where it is applied, and only there.

Now an illustration for the scab on fruit. I have a block of Newtown pippin trees standing below a hill, on rather heavy soil and too close together. These were thoroughly sprayed with Bordeaux three times and poison to test the value of the Bordeaux for the scab. I had in the same orchard three trees of the same variety on high ground in the outside row where they had plenty of light and air. All conditions most favorable to the development of the scab. These I left unsprayed. In spite of their favorable conditions two-thirds of the apples were so scabby as to be worthless, while the trees unfavorably located, but sprayed, looked as fair as oranges, and pronounced by the buyer the best he had ever seen.

One more illustration to show the effect in ridding fruit of insects. A few years ago I had strawberries in one orchard, and as the weather was very wet when we should have sprayed, the work was delayed. Fearing to injure the berries the orchard was left unsprayed. I sold my fruit that year, guaranteeing it perfect. That from the sprayed orchard sorted out only one

barrel out of eleven (and those were good seconds that brought $1.50 per barrel) that were not absolutely perfect, while the unsprayed orchard, only separated from the other by a picket fence, yielded only two barrels out of three that could go under the guarantee. Besides, the ground was covered with windfalls, and in the first orchard hardly any had fallen.

I therefore conclude that spraying pays if done *intelligently at the right time*, and *thoroughly*, and if not done this way it had better not be attempted.

Injurious Insects and How to Control Them.

By E. P. Felt, D. Sc., State Entomologist, New York State Museum, University of the State of New York.

Before considering any of the forms which so frequently attract our notice through their depredations, I will mention briefly some of the beneficial species.

Beneficial insects.—There are many parasitic and predaceous forms which prey on injurious insects and are therefore beneficial. Examples of these may be found in the numerous ichneumon flies, some of which are important parasites, or in the predaceous ground beetles, bugs and others which boldly attack our pests. A little observation will soon enable the farmer to recognize these and he will then protect or at least avoid destroying them. Professor Kellogg, of California, records an instance where a well meaning correspondent destroyed a pint of beneficial lady bugs under the impression that he was killing the depredators on his rose bushes. Other species feed on noxious plants and thus indirectly benefit man by preventing these from becoming nuisances. Insects also render valuable aid as scavengers and the myriad forms inhabiting the soil undoubtedly do much toward reducing it to a more friable, fertile condition. They are also used to some extent for food by man and the honey bee supplies a most important article for the table. Insects are also fed to poultry, song birds and in nature undoubtedly constitute a valuable food for many fish. The silk worm supplies the material for an important fabric, the cochineal and lac insects, substances of considerable value in the arts. One of the most important beneficial functions of insects consists in fertilizing the blossoms of our fruit trees, that is, carrying the pollen from flower to flower. Without the aid of bees, wasps, certain flies and other insects, it

would be impossible to obtain a full set of fruit without resorting to artificial fertilization. The enormous labor involved in this is easily understood and when we think of the number of trees and other plants that would have to be gone over and the relatively short time in which the work must be accomplished, our dependence upon insects is apparent. This emphasizes the wisdom of not spraying trees while in blossom. The spray wets the flowers, thus preventing the insects from working for a time, the poison used is apt to burn the tender parts of the flower, rendering fertilization impossible, and finally the bees themselves may be poisoned by visiting sprayed blossoms. They may even carry the poison home, kill the brood and contaminate the honey. There is also a state law prohibiting spraying trees while in bloom. So far as controlling insects is concerned, everything necessary can be accomplished by applications made either before or after blossoming time.

Losses caused by insects.—Many persons fail to realize the enormous losses caused by insects. The annual loss in the United States has been estimated at $400,000,000. Dr. C. H. Fernald, State Entomologist of Massachusetts, considers a loss through insect ravages of 10 per cent. of the value of a crop a conservative estimate. On this basis, the loss on cereals, potatoes and hay grown in New York State in 1898 would amount in round numbers to $7,000,000. Professor Slingerland, of Cornell University, estimates that the codling moth causes an annual loss in New York State of $2,500,000 on the apple crop and $500,000 on the pear crop, making a total for this insect of $3,000,000. An important point to remember in this connection is, that of 73 species regarded as of prime economic importance, that is each causing annually in the United States losses running into the hundreds of thousands of dollars, 37 are known to have been introduced, and the original home of six is still open to question. We may not be able to exclude insects from the country at large or from the state, but the individual farmer has it largely in his power to prevent certain species from obtaining a foothold on his farm. An orchard is grown not for the fruit it produces the year after it is

set out, but for the crops ten to twenty-five years later; consequently it should always be some distance from the boundary lines, so that the owner may never be obliged to suffer through the carelessness or indifference of a neighbor. All trees and plants brought on a farm should be closely scrutinized and it would be a wise precaution to fumigate all such with hydrocyanic acid gas (as recommended on a following page) or else to buy only stock which has been so treated. If these precautions are taken, a man may reasonably expect to reap nearly full benefit from his efforts to keep his orchards free from injurious insects.

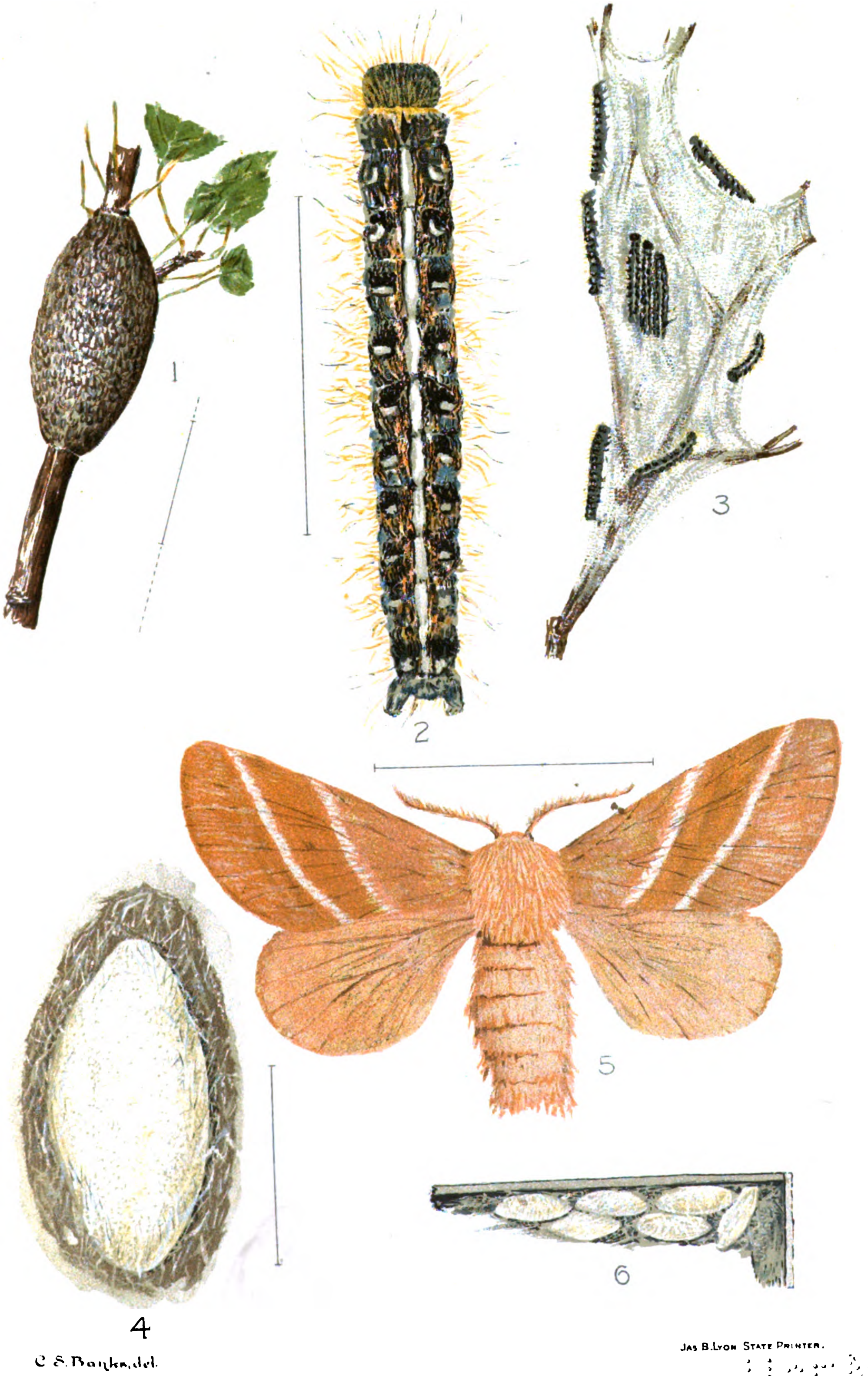
Number of injurious insects.—The number of injurious insects is so great that it is impossible to treat of all those worthy of notice. For example, 378 different species have already been listed as preying in some manner or other on the apple tree or its fruit, and while the majority of these can hardly be regarded injurious, as a rule, yet under unusually favorable circumstances almost any one of them might cause considerable damage. Before passing to the consideration of individual species, there are a few fundamental facts which should be emphasized.

Biting and sucking insects.—In a practical way we must distinguish between those insects which bite off and devour portions of their food and others which obtain their sustenance by sucking fluids from the underlying tissues. The work of the former class may easily be recognized by portions of a plant being eaten away. As a general rule such insects can be controlled by spraying with an arsenical preparation, provided the poison is placed where the insect must eat it or go hungry, and the success of the operation will be proportional to the plant surface covered. In short, when spraying with arsenical poisons aim to have the insecticide hit every portion of the plant liable to attack. The necessity of this is shown by the following: Last spring maple leaves were sprayed with several arsenical preparations. The variously treated leaves (after the spray had dried and the poison was therefore nearly invisible,) and some untreated ones were placed in separate jars and forest tent caterpillars placed

with each lot. In spite of these precautions, the caterpillars on the sprayed foliage ate very little for from twelve to thirty-six hours while those on the untreated leaves fed most readily. The same results were repeatedly noticed with the elm leaf beetle. The more successful fruit-growers make a practice of spraying every year; first as the buds are opening, second, just after the petals have fallen and before the green calyx lobes have closed, and then about seven to ten days later. Such treatment should be amply sufficient to control all orchard pests which yield to arsenical poisons. If four ounces of Paris green or other arsenical preparation is added to fifty gallons of Bordeaux mixture, we have a very effective fungicide and insecticide combined, which is of special value for the first treatment. If spraying is undertaken, it most certainly should be continued year after year, because experience has demonstrated that it is far from wise to await the appearance of a pest in force before applying the remedy.

As the arsenites lie in small particles on the surface of the plant, it is evident that an insect drawing nourishment through a slender, thread-like beak or proboscis from the interior of the plant, would be unaffected by such poisons. We must therefore fight sucking insects by using substances which will kill when thrown on the insect. That is, use a contact insecticide like kerosene emulsion, whale oil soap solution, etc. Success with contact insecticides is proportional to the number of insects hit. Spray to cover the pests with the substance. Contact insecticides are to be used whenever insect injury is accompanied by a wilting or discoloring of the affected parts and there is no tissue eaten away. The foregoing are general rules which must frequently be modified to meet special cases.

Beware of frauds.—A word of warning in this connection may not be out of place. Beware of remedies for which great claims of one kind or another are made. There are now forty-six entomologists in the United States giving a large proportion of their time to the study of insects and methods of controlling them, and unless a remedy is advised by a well known authority, it will be



Apple Tree Tent Caterpillar.

well to go slow before trying it. One of the oldest fakes is plugging trees with sulphur or some other substance said to be taken up by the sap, thus rendering the foliage distasteful to insect pests. Such claims have no foundation and should not be heeded. Yet in 1896 or thereabout, as stated to me by Mr. E. Van Alstyne, such an agent appeared in Kinderhook, N. Y., charged two dollars for plugging a tree, took in about $50 and then departed, leaving an unpaid board bill.

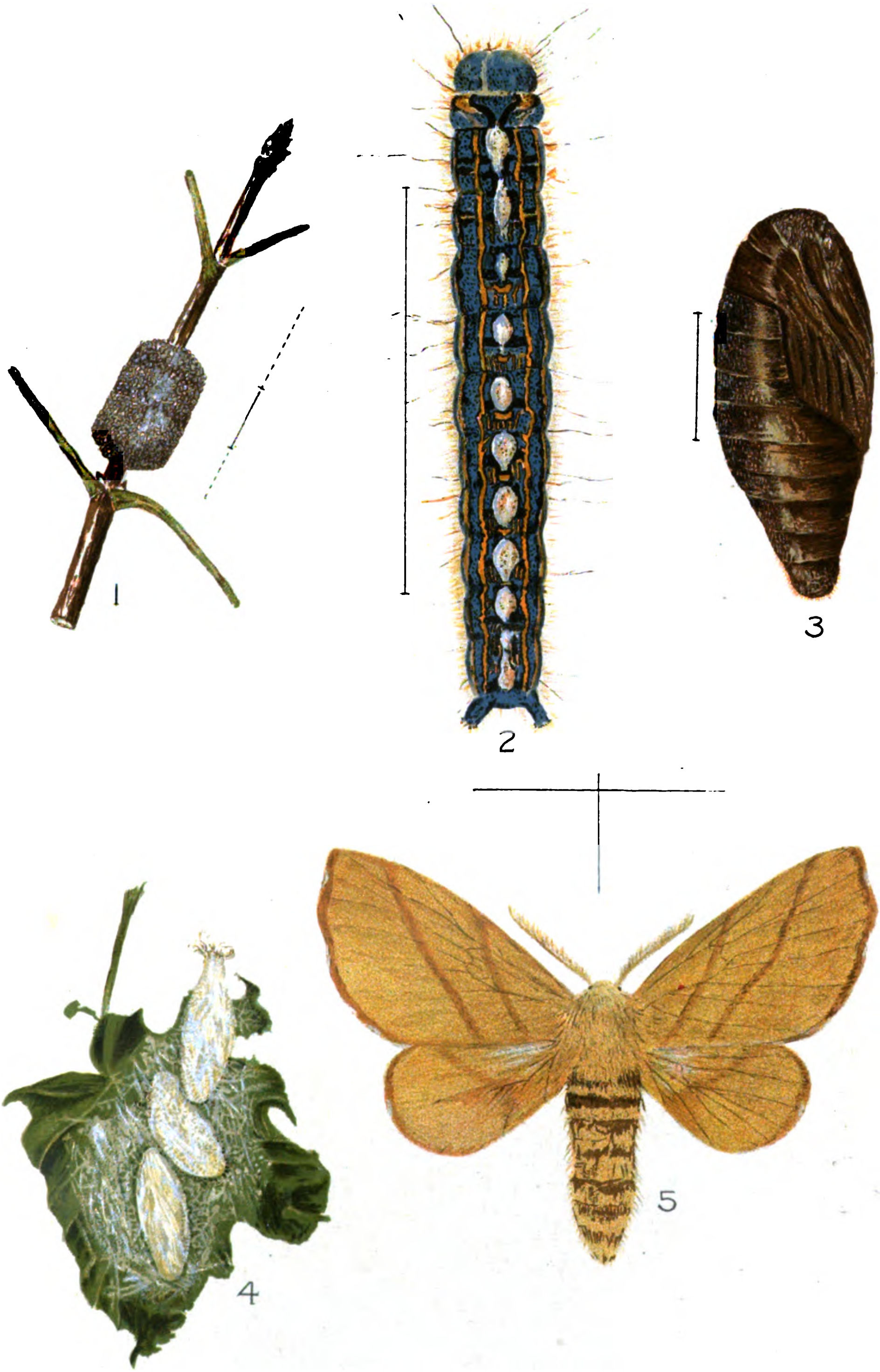
Insect changes.—The farmer should also have some general knowledge of the transformations of insects in order that he may recognize both friends and foes in their various stages. All insects develop from eggs of one form or another, though in some cases the eggs hatch within the body of the parent. The larva is the active, growing form, and is the stage more frequently destructive. It is variously known as the caterpillar, grub, maggot, "worm," etc. The pupa is the quiescent, resting stage, during which the transformation from the comparatively simple caterpilar to the highly organized butterfly or moth takes place. These changes will be more fully emphasized in the following accounts of certain injurious species:

Apple tree tent caterpillar.—This insect, *Clisiocampa americana*, yearly causes much damage in spite of the fact that its habits are well known and methods of suppressing it are understood. It passes the winter in the egg. The brownish egg mass encircling a twig is represented at figure 1 on plate 1. The young caterpillars may be found well developed within the egg in the fall and emerge therefrom in early spring. They remain in clusters under the familiar tent, feeding on adjacent foliage, and by the time they are half grown, we have the well-known condition represented at figure 3, plate 1. The caterpillars become full grown (plate 1, figure 2) the latter part of May, and at that time may be seen wandering in all directions, seeking a place for spinning their cocoons, several of which are represented at figure 6, plate 1, and one still more enlarged at figure 4. The cocoons are spun in early June and may be found in almost any

convenient crevice, affording some shelter from the elements. The pinkish brown moths, plate 1, figure 5, appear from the latter part of June into July, pair and deposit the eggs which produce caterpillars another season.

It is comparatively easy to collect and destroy the egg clusters, as most of them are on the lower limbs. If the orchard is systematically sprayed, even this is unnecessary. The creatures can also be destroyed when collected in their nests, either by tearing the nests out and crushing, or by burning. The latter is hardly advisable on account of injury to the tree.

Forest tent caterpillar.—A closely related insect and one which attracted far more attention last summer is shown on the next plate. It is variously known as the forest tent caterpillar or maple worm, scientifically as *Clisiocampa disstria*, and is a close relative of the preceding form. Like it, the winter is passed by the well-developed caterpillar within the egg. The smaller, shorter, lighter colored egg belt is represented at figure 1, plate 2. The eggs are frequently found in large numbers on small sugar maples, if there be any in the vicinity. On moderate-sized trees, a large proportion are found on twigs within twenty or thirty feet of the ground, while on large trees it is not unusual to find them in considerable numbers at a greater height. The caterpillars begin to emerge from the eggs with the advent of warm weather in the spring and continue to appear for about a month. The first evidence of infestation, if the eggs have not been previously noticed, is a thinning of the upper leaves. The young caterpillars may be found in clusters on the branches, and as they increase in size the clusters are found lower and lower, till, when nearly full grown, large patches may be found on the trunks of the infested trees. It will be seen by comparing figures 2 on plates 1 and 2, that the forest tent caterpillar is characterized by the possession of a row of somewhat diamond-shaped silvery spots down the middle of the back, while the apple tree tent caterpillar has a narrow dorsal line of the same color. The forest insect does not form a tent in the crotches of the limbs, a habit so characteristic of the species usually found



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Forest Tent Caterpillar

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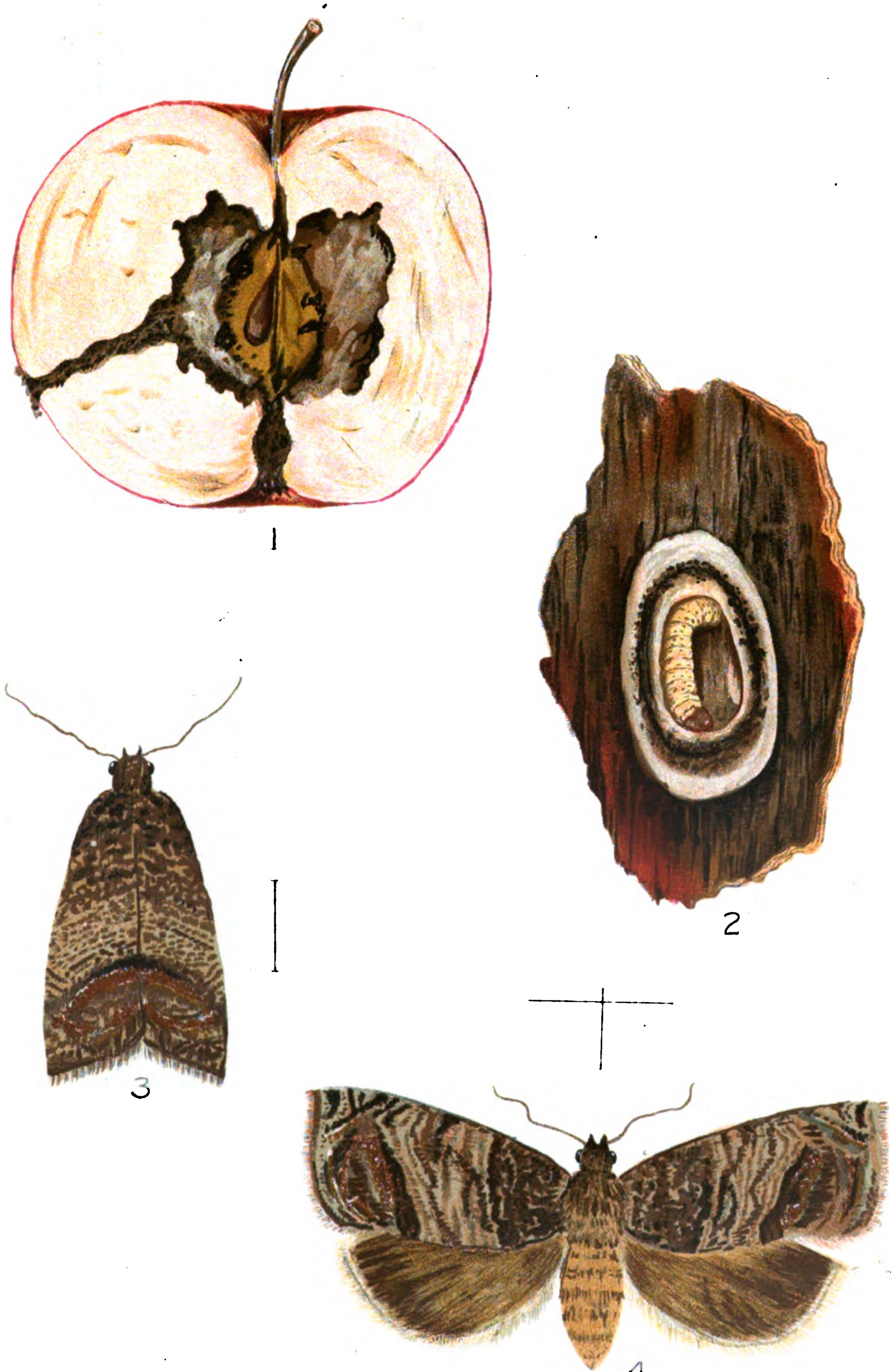
on apple trees. The full-grown caterpillars wander in search of a place to spin cocoons about the first of June, spinning up about the middle of that month, but some may be found the latter part of June and even in early July, so irregular is their development. The cocoons, as frequently spun in a leaf, are represented at figure 4, plate 2. They may also be found under ledges of houses, in fence corners and almost any convenient shelter. The moths may be taken from the latter part of June into August, being most abundant in early July. Pairing takes place at this time, and the eggs are deposited for the next year's generation. As is well known, this species has a special fondness for sugar maples, and has caused much injury to the sugar bush of this and the adjoining State of Vermont. The effect attacks by this insect have is shown by the following: Mr. Tremain Bloodgood, of Hensonville, Greene county, found that maples defoliated in 1897 and '98 yielded in 1898 and '99 one-half the usual amount of sap, and that more of it was required to make one pound of sugar, though the quality of the latter was not affected. Mr. Jared Tiffany, of East Jewett, found that the largest and best maples suffered most, and that two or three defoliations kill a tree or render it practically worthless, as the flow of sap is very small and the little secured is almost unfit for use. Professor Perkins, entomologist of the Agricultural Experiment Station of Vermont, reports that the crop was not one-half or two-thirds the usual amount in his State, and that the yield was light even in localities where the tent caterpillar was not abundant. In most places it is hardly probable that the pest will be abundant for more than three or four years in succession.

Value of native birds.—The cause leading to the outbreak of this native species is interesting and worthy of some attention. The pest is undoubtedly controlled to some extent by climatic conditions, and insect parasites are also valuable aids in keeping it in subjection. Unfortunately, we can not control climate, and there is not much that is practicable in the way of encouraging or protecting parasites. It is believed that the native birds are

important aids in keeping this insect in control. Mr. E. H. Forbush, ornithologist to the Massachusetts State Board of Agriculture, has kindly supplied me with the following list of native birds observed feeding on forest tent caterpillars: Oriole, black-billed cuckoo, yellow-billed cuckoo, crow, blue jay, redstart, nuthatch, wood thrush, chewink, black and white creeper, red-eyed vireo, flicker and scarlet tanager. Mr. V. H. Lowe has observed the black-capped chickadee feeding on the eggs and the robin on the caterpillars, beside others mentioned. Professor C. M. Weed states that the robin, chipping sparrow, yellow bird and English sparrow feed on the moths. In view of the fact that our best authorities have estimated that bird life in New York State has decreased 48 per cent. in the past fifteen years, it seems reasonable to attribute this outbreak by forest tent caterpillars in part to the decline in the number of birds. The following accounts illustrate the value of our feathered friends: In a typical orchard at Medford, Mass., Mr. Forbush took a little trouble to attract the native birds, the nests of the English or house sparrow being destroyed. The results were greatly in favor of protecting our indigenous forms. In the neighboring orchards it was evident that canker worms and tent caterpillars were abundant, but in the orchard in question the trees were seriously injured in only one or two instances, though no attempt was made to control the insects by spraying or other artificial means. The following note relating to forest tent caterpillars is by Miss Caroline G. Soule: "The nuthatches would stand by a patch of larvæ lying close together below a tar band on a tree and eat so voraciously and with such an entire abandonment of self-consciousness that I could go close and put my hand on them before they would fly. This experience was repeated several times."

Our native birds are undoubtedly of great value and will richly repay any slight effort that may be made for the purpose of attracting them to a neighborhood. Winter birds may be induced to remain in a locality by hanging in the trees pieces of meat or partially picked bones, and will spend much time in searching



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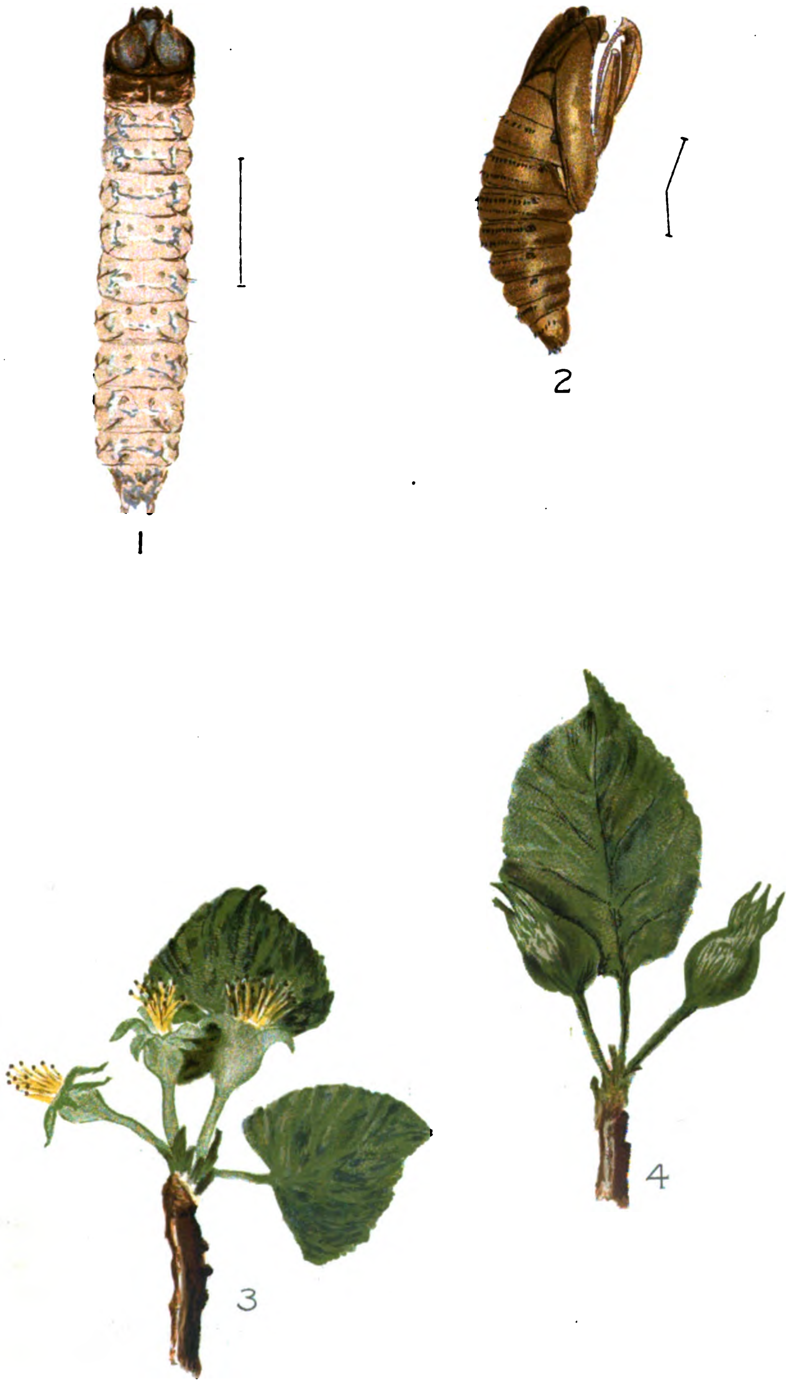
Codling Moth

out and devouring numerous insects and their eggs, relying on the meat only when conditions are unfavorable for obtaining insect food. Migratory birds may be induced to remain in larger numbers in a locality by providing them with suitable nesting places and materials, and by affording them protection from cats and other enemies, not excepting man. Thickets in the vicinity will afford shelter for certain species, and if a few mulberry trees are set out their fruit will serve to protect the cherries, as the birds are said to eat mulberries by preference. Most of these suggestions are taken from a very practical paper by Mr. Forbush.

Remedies for forest tent caterpillar.—There is little that can be done to prevent the ravages of this insect in forests and large sugar bushes, aside from protecting birds, but in orchards, on shade and other of the more valuable trees it is practicable to fight this insect in the egg, caterpillar and cocoon stages. During the winter and early spring the lower twigs bearing egg clusters should be cut off and burned. Every egg mass thus destroyed means approximately 200 less caterpillars to fight the coming spring. As soon as the pests cluster in the trees, they should be brushed down or dislodged with a torch. The latter method is hardly advisable on account of the danger of injuring the tree. Many caterpillars can be jarred from the limbs. In whatever way they are gotten out of the tree, bands should be employed to prevent the caterpillars from ascending. A strip of cotton batting tied tightly around its middle to the trunk and the upper portion turned back over the string makes a very effective barrier so long as it remains dry. Bands of tar, grease, equal parts of lard and sulphur, etc., are very effective in preventing the creatures from climbing the trees, once they have been gotten out. If these latter substances are used, it will be safer to first put on a band of thick paper and apply the grease or tar to it, thus avoiding danger of ultimate injury to the bark. Wherever the caterpillars are at all abundant, it will probably be necessary to kill those collecting below the bands with hot water, kerosene emulsion or by crushing. These insects yield readily to arsenical poisons,

particularly if the application is timely, but conditions are not always such that spraying is practicable. Sometimes when the caterpillars are present in very large numbers and the poison has not been applied till late, the trees may be stripped in spite of the insecticide, but under ordinary conditions there need be little fear of the poison proving ineffective. Where spraying is not done, it will probably be wise to supplement the destruction of eggs and caterpillars by collecting and burning the cocoons. The village of Glens Falls, and several others, paid school children 10 cents per quart for collecting the cocoons in 1899, and excellent results were obtained. At Glens Falls 1350 quarts of cocoons were destroyed. Whenever this is done to any great extent, it would be well to put the cocoons in boxes covered with a wire netting, about 3-16 inch mesh, so as to allow the smaller parasites to escape and yet to confine the moths. When the caterpillars are present in large numbers nothing but the most vigorous measures will prevent severe injuries to the infested trees.

Codling moth.—One of the most important orchard insects to-day is the common codling moth or apple worm, *Carpocapsa pomonella.* The wormy apple, well represented at figure 1, on plate 3, is familiar to most of us. Were we to go into the orchard in winter and look under partly loosened bark scales, we would find a condition very much as represented at figure 2, on plate 3. Under the loose bark there is a silken cocoon and within it a partly curled, whitish worm or caterpillar, which is represented much larger at figure 1, plate 4. The winter is passed in this condition. In the spring the transformation to the pupa occurs and about the time the apple trees blossom, the moths (plate 3, figures 3, 4) come forth. About a week later the eggs are laid on the leaves or sides of the young fruit and in about two weeks from blossoming the young caterpillar or apple worm emerges from the egg and usually enters the fruit at the blossom end. This habit renders the control of the pest by spraying comparatively easy, provided it is done thoroughly and at the right time. Any time after the white petals have fallen and before the green calyx lobes have closed is the proper time to spray for this pest. Figure 3 on



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Codling Moth

plate 4 shows the calyx lobes open and in the right condition for spraying and figure 4 the condition when the calyx lobes have closed and the impossibility of throwing the poison where it will be most effective. It may be well to delay spraying a few days after the blossoms have fallen so as to reduce to a minimum the danger of having the poison washed out of the blossom cup by rains, but delay beyond a certain period is dangerous because the calyx lobes in most varieties of apples close in about two weeks after the petals fall and then it is too late to do effective work against this insect. Ample time allowance should be made, as the spraying may be hindered by bad weather. The spray should be rather coarse because then it fills the calyx cup more readily. There is practically no danger in spraying young apples with arsenical poisons.

Those who do not or can not resort to spraying must depend on the destruction of the infested fruit shortly after it falls. One correspondent found comparative immunity from this pest by allowing hogs to run under his apple trees. Sheep or other domestic animals could be utilized in the same manner to good advantage in certain cases. As the apple worms leave the fruit when full grown and spin cocoons under shelters on the trunks, banding the trees and destroying the cocoons found underneath aids materially in reducing the numbers of this pest. Scrape the trunk smooth and apply a band of cheap paper, burlap or similar material in June. These bands should be examined every ten days till August and then once in the fall, destroying all found under the shelter. As many of the pests are liable to be carried into the fruit cellar, it is always wise to prevent the escape of the moths in the spring by covering all openings with fine wire netting.

Sugar maple borer.—The sugar maples in many villages show most serious injury by the sugar maple borer, *Plagionotus speciosus*. This insect is specially dangerous because the large, white, fleshy grubs thrive in healthy trees and have the pernicious habit of running their large burrows through the inner bark and sap wood. As many of these burrows have a transverse, oblique

direction for a part of their course, it is by no means uncommon to see trees partly girdled through the activity of this borer. I have seen maples fifteen and eighteen inches in diameter half girdled by a single burrow. It is apparent to all that only a few such borers are necessary to cause considerable injury. The beautiful parent beetle, represented at figure 1, is rarely seen, but evidences of the insect's work are very apparent. The large, white, fleshy grub or borer is not often observed. It is a most insidious worker and probably the best method of controlling it on shade trees is to search each fall for the discolored, wounded areas, showing the place where the young larvæ have entered the bark, and then to destroy the pests. There is little danger of harming the tree more by digging the borer out than the creature would if left to itself.

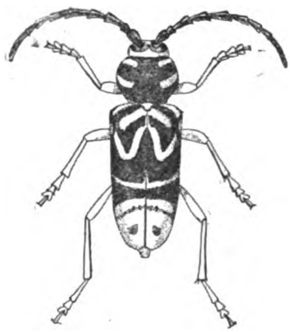
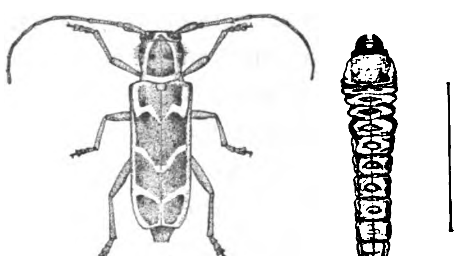


FIG. 1 Sugar maple borer, parent beetle (original).

The young borers frequently enter the tree at favorable points on the trunk and branches just as the larger limbs spring out from the main stem. Applications of the soap carbolic acid wash about the middle of May, and renewal of the same in June, would probably aid somewhat in preventing the deposition of eggs, though at present it is impossible to state the true value of this preventive.



a b

FIG. 2 Elm borer: *a* adult; *b* half grown larva—hair line represents natural size of latter (original).

Elm borer.—American elms are frequently attacked by a borer working beneath the bark. There is no practical method of fight-

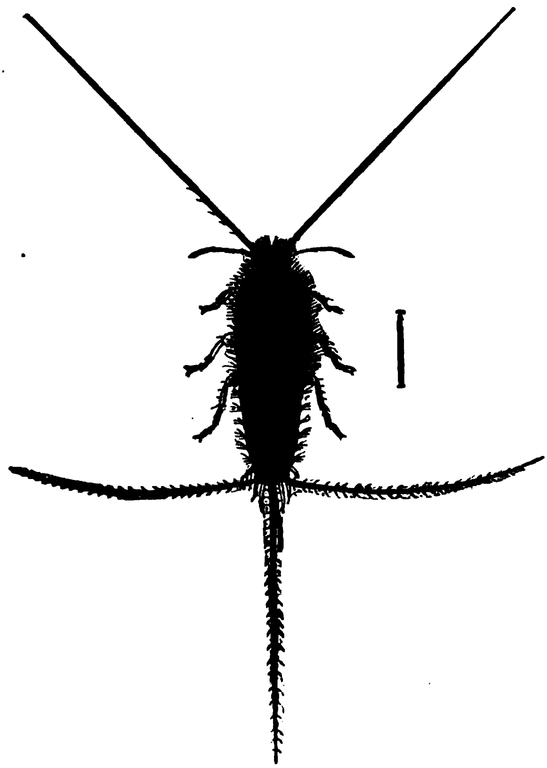


FIG. 5—*Lepisma Domestica* (After Marlatt: U. S. Dep't Agricultur Division Entomology, Bulletin 4).

Old fruit enemies.—Apple tree bark louse, *Mytilaspis pomorum.* The general form of the brown scale of this insect is nicely shown at *a* in figure 4 and were we to examine infested trees in winter we would find under the old scales large numbers of tiny white eggs. The scurfy bark louse, *Chionaspis furfurus*, is represented at *b* in figure 4. The common name is descriptive of the white,

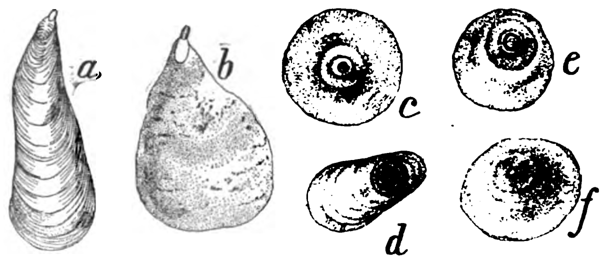


FIG. 4 Scale insects: *a* apple tree bark louse; *b* scurfy bark louse; *c* San José scale *d* male of same; *e* English oyster scale; *f* Putnam's scale (original).

scurfy condition of badly-infested trees. On breaking away the protecting scale in winter numbers of purplish eggs may be found occupying the scale cavity. The winter is passed by both species in the egg stage. About June 1st the young appear and may be seen crawling in large numbers over the trunk and limbs of the infested trees. Either of these scale insects can be kept under control by spraying the young with a contact insecticide like whale oil soap solution, kerosene emulsion, the formulas for which are given at the close of this article.

San José scale.—The most important pest represented in figure 4 is this species, *Aspidiotus perniciosus.* Figure 4*c* represents the female scale and at *d* the male scale is shown. Observe the roundness of the ash-gray scale, the central nipple and the lighter ring surrounding it. The adult female scales are frequently considerably larger and of a yellowish white color. The scale covering these insects is quite variable, and it requires considerable experience to enable one to distinguish with surety between this species and certain closely related forms and even then the entomologist frequently prefers to take the trouble to make a mount for the microscope and study the insect itself before passing on the identity of the species. A closely related form is *Aspidiotus ancylus*

or Putnam's scale. It is represented at figure 4*f*. It can be separated at once from the San José scale by the eccentricity and the yellow or reddish color of the nipple. There is another species, *Aspidiotus ostreæformis* (figure 4*e*), which resembles the San José scale very closely indeed. If trees are infested by scale insects or even present a suspicious appearance, it is by all means advisable to cut off a small twig and submit the same to some entomologist for examination. The San José scale is dangerous on account of its inconspicuousness and also because of its great prolificacy. A tree may be nearly covered by this scale and nothing be suspected. I have known such to be the case, even when a bright and intelligent man and his two boys had endeavored to keep posted and had been looking for the creature. Careful studies have shown that in the latitude of Washington, D. C., four and even five generations could be produced in a year and that the descendants from one female might in one season reach the enormous estimate of 3,216,080,400 individuals. In New York state not over three generations annually would probably be the rule, but even with our climatic conditions the insect is able to keep up with a rapidly growing apple tree, as is shown by a twig fifteen inches long of 1898 growth being nearly covered with the scale at the end of that season.

Very diverse opinions are held regarding this insect and its destructiveness. It is at least a pest no man cares for and it is much easier to exclude it from the farm than to maintain a perpetual warfare to keep it in subjection. There are many sections in the state where this pest has not become established and thousands of farmers and horticulturists are in a position to prevent the San José scale from gaining a foothold in their orchards. To every such person I would say, buy only trees that have been fumigated with hydrocyanic acid gas or else fumigate every tree and shrub before it is set out. This measure is not only our most practical method of safeguarding against the introduction of the San José scale but is equally valuable against many other imported insects. The importance of this latter has already been emphasized. Nothing but the most heroic measures will stamp out the pest after it has become established and these will be

successful only in places where the infestation is very limited. If but few trees are infested and there is no danger of its being in nearby localities, it would be far wiser promptly to destroy everything bearing the scale and start anew, rather than attempt to save the trees. An infestation of considerable extent can hardly be fought otherwise than by repeated treatments with contact insecticides. Whale oil soap has proved about as effectual as any, though the mechanical kerosene emulsion has been strongly endorsed by some. Perhaps the most promising treatment is found in the use of a 20-per-cent. mechanical emulsion of crude petroleum applied in early spring before the buds start. There is no doubt of its killing a large proportion of the scales. There is less danger to the fruit buds if winter treatment be delayed till early spring and if crude petroleum emulsion be used, the viscid residue remains sometimes on the limbs and trunk and is very unfavorable to the establishment of young scales. Crude petroleum cannot be applied to leaves but it is said to injure only growing wood, even in summer. Its use undiluted cannot be recommended at present. The summer treatment with other contact insecticides consists of several sprayings from when the young begin to appear, sometime in June, till late fall. The frequency of the spraying should depend largely on the abundance of the young. The summer work is usually supplemental to the winter operations. The formulas of contact insecticides for either summer or winter use are given on a subsequent page.

The following catalogue, descriptive of the insects in a small traveling collection of the more important species, was prepared by the State Entomologist and published in a convenient pocket form for distribution at farmers' institutes:

Fruit Tree Insects.

1 **Apple tree tent caterpillar** (*Clisiocampa americana*). Conspicuous web tents in forks of apple and cherry trees contain hairy caterpillars with a white stripe along the back. Cocoons spun the last of May, the light brown moths flying in June. Eggs, in belts encircling the smaller twigs, remain unhatched till spring.

Treatment: remove and destroy eggs or young in nests. Spray foliage of infested trees with poison in early spring.

2 **Codling moth** (*Carpocapsa pomonella*). Familiar as the worm boring in apples near the core. The winter is passed in small cavities under sheltering bark or in crevices.

Treatment: band trees and kill worms collecting under them; destroy wormy apples, spray with poison when calyx lobes are open. Prevent escape of the moths from fruit houses and cellars.

3 **Cigar case bearer** (*Coleophora fletcherella*). Small caterpillars in cigar-shaped cases feeding on buds and foliage of apple.

Treatment: spray infested trees with poison in early spring.

4 **Pistol case bearer** (*Coleophora malivorella*). Small caterpillar in pistol shaped cases feeding on the young leaves and opening flower of the apple.

Treatment: spray infested trees with poison in early spring.

5 **Apple leaf Bucculatrix** (*Bucculatrix pomifoliella*). White ribbed cocoons about ¼ inch long may be seen in clusters on smaller limbs of infested trees. The small larvæ mine the leaves and later feed externally.

Treatment: spray infested foliage with poison in early June.

6 **Rose beetle** (*Macrodactylus subspinosus*). Greenish yellow beetles about ⅜ inch long appear in swarms in May and attack the foliage of various trees and vines.

Treatment: spray beetles with ½ pound whale oil soap to 1 gallon water, dust vines with ashes, etc.; handpicking.

7 **Apple tree borer** (*Saperda candida*). "Sawdust" or diseased bark and beneath the latter, legless, white, round headed borers. The brown beetles, striped with white, about 1 inch long, occur from June to August.

Treatment: protect base of tree with wire netting. Dig out the young borers in the fall. Cut and burn badly infested trees.

8 **Pear midge** (*Diplosis pyrivora*). Dwarfed, deformed, fruit drops early, and within occur thick-bodied, pale yellow maggots.

Treatment: destroy infested fruit.

9 **Peach bark borer** (*Scolytus rugulosus*). Bark of affected trees punctured with many small, circular holes, made by brownish black beetles, less than ⅛ inch long. Inner portions of bark and sap wood filled with burrows.

Treatment: burn badly infested trees. Apply carbolic soap wash to trunks and limbs in early spring.

10 **Pear blight beetle** (*Xyleborus dispar*). Bark of affected trees punctured with many small, circular holes made by dark brown beetles about ⅛ inch long. Inner portions of bark and sap wood filled with burrows.

Treatment: burn badly infested trees.

11 **17-year Cicada** (*Cicada septendecim*). Slit and broken twigs with wilting leaves are characteristic work of this insect, but unless the trees are small not much damage is done.

Treatment: avoid setting out trees in last few years before Cicadas are due.

12 **Apple tree bark louse** (*Mytilaspis pomorum*). Bark infested with brownish scales shaped like oyster shells. Occurs on many other trees. Winter passed as white eggs under old scales, the young appearing about June 1.

Treatment: spray young with kerosene emulsion or whale oil soap solution.

13 **Scurfy bark louse** (*Chionaspis furfurus*). The whitish, scurfy scales occur on the bark of fruit trees. The purplish eggs remain under old scales all winter, the young appearing about June 1.

Treatment: spray young with kerosene emulsion or whale oil soap solution.

14 **San José scale** (*Aspidiotus perniciosus*). A small circular scale not readily seen unless very abundant. Infests many trees and shrubs. The specimens exhibited showed variations in the appearance of the scales and how it may be disseminated by budding. Young appear from early June till cold weather.

Treatment: destroy badly infested trees, specially if young, and spray others thoroughly in early spring with 20 per cent mechanical emulsion of crude petroleum, kerosene emulsion or whale oil soap solution. Fumigate with gas.

15 **English oyster scale** (*Aspidiotus ostreæformis*). Resembles San José scale in appearance and like it infests fruit trees. Occurs in several localities in this State and should be guarded against.

Treatment: spray infested trees with kerosene petroleum or emulsion, or whale oil soap solution. Fumigate with gas.

16 **Putnam's scale** (*Aspidiotus ancylus*). Resembles the two preceding species, but is less injurious. Attacks various trees.

Treatment: same as preceding.

Small Fruit and Vine Insects.

17 **Currant worm** (*Pteronus ribesii*). Greenish, black dotted saw fly larvæ feeding on currant leaves in May, the common currant worm.

Treatment: spray with hellebore.

18 **Currant span worm** (*Diastictis ribearia*). Yellowish, black dotted span worms feeding on leaves in May and June.

Treatment: spray with poison or handpicking.

19 **Currant stem borers** (*Sesia tipuliformis, Janus integer, Tenthredo rufopectus*). The caterpillars boring in the woody stems are sesians. The maggots working in the tender tips may be either those of *Janus* or *Tenthredo*.

Treatment: burn stems infested with sesians and the wilting tips infested by the others.

20 **Raspberry gouty gall beetle** (*Agrilus ruficollis*). Irregular swellings on canes are produced by larvæ of this pest.

Treatment: cut and burn infested canes during winter or early spring.

21 **Light loving grapevine beetle** (*Anomala lucicola*). Brownish or black beetles about ⅝ inch long resembling a small June beetle.

Treatment: dust vines with lime. Collect and destroy beetles.

22 **Spotted grapevine beetle** (*Pelidnota punctata*). Brown, black spotted beetles about 1 inch long resembling a June beetle.

Treatment: handpicking.

23 **Grapevine flea beetle** (*Haltica chalybea*). Greenish or blue beetles about ⅛ inch long feeding on buds, or brownish, black dotted larvæ about ½ inch long skeletonizing leaves.

Treatment: spray with poison, using a large amount on buds, less for young on leaves.

24 **Grapevine plume moth** (*Oxyptilus periscelidactylus*). Small, greenish, hairy caterpillars webbing together terminal leaves.

Treatment: pick and destroy infested tips.

25 **Eight spotted forester** (*Alypia octomaculata*). Reddish, black ringed caterpillars about ½ inch long feeding on grapevine and Virginia creeper in spring.

Treatment: handpicking; spray with poison.

26 **White flower cricket** (*Oecanthus niveus*). Series of punctures in twigs of various kinds are made by this insect for the reception of its eggs. Injury is usually too little to call for remedial measures, specially as the insects are predaceous and therefore beneficial.

Shade Tree Pests.

27 **White marked tussock moth** (*Notolophus leucostigma*). Beautiful caterpillars having three black plumes, four yellow or white tufts, a coral red head, and body marked with black and yellow; defoliate horse chestnut, elm and other shade trees. Winter passed in white, frothy egg masses, the caterpillars hatching the latter part of May and spinning up about a month later, the moths appearing in July. Two broods about New York city, but one farther north.

Treatment: destroy eggs or spray foliage of infested trees with poison.

28 **Forest tent caterpillar; maple worm** (*Clisiocampa disstria*). Foliage of maple and fruit trees eaten in May and June by hairy blue headed caterpillars with silvery spots along the back. Cocoons spun in June, the brown moths flying in July. Eggs, in belts encircling smaller twigs, remain unhatched till spring.

Treatment: destroy eggs; kill the caterpillars when massed on trunk and limbs; spray foliage of infested trees with poison; collect and destroy cocoons.

29 **Pigeon Tremex** (*Tremex columba*). Adults, frequently known as "horn tails," are usually found in July around diseased and dying tree trunks. The young borers occur near the surface, but full grown ones may make their way to the center of even large trees. Not usually very injurious.

Treatment: cut and burn badly infested trees.

30 **Lunate long sting** (*Thalessa lunator*). Brownish, wasp-like insect with yellow markings and a slender ovipositor or "tail" 2 to 4 inches long. Frequents elms and maples infested by the pigeon Tremex and is occasionally found with the ovipositor stuck in the wood. The white, legless grubs attach themselves to the borers and suck their life out. *This insect should* therefore *be protected.*

31 **Cottony maple tree scale insect** (*Pulvinaria innumerabilis*). Under side of smaller limbs sometimes festooned with this cottony insect, though more frequently it occurs in small masses. Young appear in July.

Treatment: spray with kerosene emulsion or whale oil soap solution. Brush or scrape off and destroy the old scales.

32 **Sugar maple borer** (*Plagionotus speciosus*). Diseased or loose bark and exposed dead wood indicate the work of this pest. The grubs frequently cause serious injury by running transverse burrows just beneath the bark. The stout, black beetles about 1 inch long with bright yellow markings, occur from June to August.

Treatment: burn badly infested trees. Dig out the young borers in the fall. Protect trees with carbolic soap wash from June to August.

33 **Maple tree pruner** (*Elaphidion villosum*). Small limbs of maple, oak and other trees nearly eaten off by an insect and dropping in September, usually contain the pupæ of this species.

Treatment: collect infested limbs on the ground and burn before spring.

34 **Elm leaf beetle** (*Galerucella luteola*). Irregular round holes eaten in young foliage followed by the grubs gnawing the under portions of the leaves, which then dry and turn brown. The yellowish, black striped beetles, about ¼ inch long, appear in early spring and lay eggs in May. The grubs feed in June, changing to yellow pupæ the latter part of the month. A second brood occurs in July and extends into September. Known in this State only on Long Island, in the Hudson River valley and in scattered localities in central New York.

Treatment: spray foliage of infested trees with poison, which *must be applied to under surface* of the leaf in order to kill the grubs. Kill larvæ and pupæ on and near trunks of the trees.

35 **Elm bark louse** (*Gossyparia ulmi*). Adult females in June appear like clusters of small lichens on the under side of the smaller limbs of European elms. Young emerge in July.

Treatment: spray with kerosene emulsion or whale oil soap solution.

36 **Elm borer** (*Saperda tridentata*). Diseased or dead bark and in inner portions white, flattened legless grubs, which frequently cause considerable injury. Beetles appear from early May till latter part of June.

Treatment: cut and burn badly infested trees. Protect valuable trees with carbolic soap wash during May and June.

37 **Elm snout beetle** (*Magdalis barbita*). Thick, fleshy, legless grubs working in inner bark of elm. Follows attack by the elm borer and occasionally is very abundant.

Treatment: burn badly infested trees and keep others vigorous.

38 **Fall web worm** (*Hyphantria cunea*). Web tents in July and August inclosing leaves on the tips of branches, the eaten foliage turning brown. Attacks many trees.

Treatment: destroy webs and their inhabitants or spray foliage of affected limbs with poison.

39 **Bag worm** (*Thyridopteryx ephemeræformis*). Defoliated evergreens and other trees are found infested with curious cocoons or bags containing caterpillars in late summer and fall. Occurs in vicinity of New York city.

Treatment: collect and destroy bag worms or spray with poison.

40 **Leopard moth** (*Zeuzera pyrina*). Whitish, black spotted caterpillars making large burrows in various trees. A bad pest about New York city.

Treatment: dig out young borers. Kill others with carbon bisulfid. Destroy badly infested trees.

41 **Bronze birch borer** (*Agrilus anxius*). If injured bark is examined, a slender flat headed grub will be found running burrows in all directions in the inner portions. White and other birches are attacked. Very injurious at present in Buffalo. Beetles appear in June.

Treatment: cut and burn badly infested trees.

Garden Insects.

42 **Colorado potato beetle** (*Doryphora 10-lineata*). Stout yellowish beetles with black striped wing covers appear in early spring, feed and deposit yellowish eggs in clusters on under surface of leaves. The reddish, black marked grubs also devour the foliage.

Treatment: handpicking; spray vines with poison.

43 **Squash vine borer** (*Melittia satyriniformis*). Wilting of one or more runners is caused by a whitish caterpillar boring in the stem near the root.

Treatment: slit the softer, infested portion of the vines, remove the borers and cover the wounded part with earth. Protect young plants with netting.

44 **Striped cucumber beetle** (*Diabrotica vittata*). Yellow beetles about ¼ inch long, striped with black, occur in numbers on cucumber and squash vines.

Treatment: protect young vines with netting. Dust vines with ashes, plaster of paris, etc. Poison trap crop of squash.

45 **Cucumber flea beetle** (*Epitrix cucumeris*). Brownish, gnawed spots on leaves made by numerous black jumping beetles about 1-16 inch long.

Treatment: Spray vines with Bordeaux mixture.

46 **Squash bug** (*Anasa tristis*). Wilting leaves with their under surface infested by greenish young or the large grayish brown stink bugs about ¾ inch long.

Treatment: place chips and similar shelters near the vines and kill daily the bugs collected underneath. Crush the brownish eggs on under surface of the leaves.

47 **Common asparagus beetle** (*Orioceris asparagi*). Slate colored grubs about ⅛ inch long or yellowish and bluish green beetles about ¼ inch long eating the more tender portions of the plants. Occurs on Long Island, in Hudson River valley and in the lake regions of the western part of the State.

Treatment: dust young plants when wet with dew with plaster of paris and poison.

48 **12-spotted asparagus beetle** (*Crioceris 12-punctata*). Slate colored grubs about ⅛ inch long or stout, nearly cylindric red beetles with 12 black spots, eating the more tender portions of the plant. Known to occur in the State in a number of widely separated localities.

Treatment: same as above.

49 **Flea beetle on sugar beets** (*Systena frontalis*). Ragged holes and brown spots made by small, jumping, black, red-headed beetles about 3-16 inch long.

Treatment: spray affected plants with poison or bordeaux mixture.

50 **Blister beetles** (*Epicauta cinerea E. vittata*). Feeding in July and August on the foliage of potato and other plants, cylindric, soft beetles about ⅝ inch long and black and gray, or black striped with yellow.

Treatment: as the grubs of these beetles are known to feed on the eggs of grasshoppers and are therefore beneficial, the adults should be destroyed, by spraying affected plants with poison or by beating the insects into pans containing water and kerosene, only when necessary.

51 **Bumble flower beetle** (*Euphoria inda*). Brownish, mottled beetles about ⅝ inch long, feeding in ears of green corn, attacking peaches.

Treatment: handpicking.

52 **Wireworms** (*Elateridæ*). Cylindric, hard, yellowish brown creatures attacking various plants, frequently injuring planted seeds.

Treatment: fall plowing. Trapping beetles with poisoned baits.

53 **Stalk borer** (*Hydrœcia nitela*). Wilting potato vines and within a brown, white striped, active caterpillar about 1 inch long. Attacks many thick-stalked, herbaceous plants.

Treatment: burn infested stalks before September.

54 **Variegated cut worm** (*Peridroma saucia*). Stout, brownish cut worms with obscure markings and about 1½ inches long. Injurious to various garden plants.

Treatment: place poisoned baits near plants to be protected.

55 **Zebra caterpillar** (*Mamestra picta*). Brilliantly marked black and yellow, red-headed caterpillar about 2 inches long frequently found on cabbage, beets and other garden crops.

Treatment: spray affected plants with poison, hellebore or pyrethrum water.

56 **Cabbage butterfly** (*Pieris rapæ*). Large irregular holes eaten in cabbage by a greenish caterpillar. White butterflies abundant in the field.

Treatment: capture the butterflies with nets. Spray young cabbage with poison, older ones with hellebore or pyrethrum water. Dust with lime.

57 **Cabbage thrips** (*Thrips tabaci*). Cabbage and lettuce show white spots as though blasted, caused by minute yellowish or brown insects.

Treatment: spray affected plants with kerosene emulsion or a soap solution.

58 **Tarnished plant bug** (*Lygus pratensis*). Small yellowish and black bugs about ¼ inch long frequenting many plants and injuring most garden crops and some trees.

Treatment: handpicking or dusting with ashes. Burn all rubbish in the fall.

59 **Four lined leaf bug** (*Pœcilocapsus lineatus*). Yellowish bugs with four black stripes, about 5-16 inch long, frequenting various plants and injuring some considerably.

Treatment: dust affected plants with ashes. Spray young with kerosene emulsion. Cut and burn tips of bushes containing eggs.

Grass Insects.

60 **Army worm** (*Leucania unipuncta*). Brownish, white striped caterpillars about 2 inches long devouring grasses and allied plants.

Treatment: confine by ditching, kill with poisoned baits. Prevent their occurrence by clean culture.

61 **White grubs** (*Lachnosterna fusca, Allorhina nitida*). Fleshy, white, brown-headed grubs severing grass roots and those of other plants. Allorhina occurs in vicinity of New York city.

Treatment: spray badly infested areas liberally with kerosene emulsion just before a rain. Dig and destroy the grubs.

62 **Grasshoppers.** A number of species attack various crops.

Treatment: place poisoned baits near crops to be protected.

Household Insects.

63 **House fly** (*Musca domestica*). Easily recognized as the common fly around houses.

Treatment: exclude with screens. As it breeds in manure and garbage, keeping this material cleaned up or inaccessible to flies will reduce their numbers.

64 **Bed bug** (*Acanthia lectularia*). A flattened, reddish insect about ¼ inch long frequenting houses, specially those affording numerous cracks where it can find shelter and where uncleanliness prevails.

Treatment: apply benzine, kerosene or other petroleum oil to crevices in infested beds. Corrosive sublimate may be used in same manner. Fumigation with sulphur is valuable wherever possible.

65 **Kissing bug: masked bed bug hunter** (*Opsicœtus personatus*). A brownish or black insect about ¾ inch long. It is attracted by lights, and its young, which conceals itself by a covering of lint, etc., is said to have a partiality for bed bugs. Not usually harmful, though it can inflict a severe bite or "sting."

Treatment: screens should exclude it most effectually.

66 **Buffalo carpet beetle** (*Anthrenus scrophulariæ*). Larvæ easily recognized by their shaggy appearance, being provided with coarse bristles along the sides and at the posterior extremity of the body. The beetles are about ⅛ inch long, black, marked with white and a red line widening into three projections, down the middle of the back.

Treatment: use rugs or matting in place of carpets whenever possible. Infested carpets should be taken up and sprayed with benzine and the cracks in floors should be filled with plaster of paris before relaying the carpet.

67 **Black carpet beetle** (*Attagenus piceus*). Light brown, cylindric larva with a long "tail" of slender hairs. The adult is a small, oval, black beetle about ⅛ inch long. This species has a decided taste for feathers.

Treatment: Same as for the preceding.

68 **Little red ant** (*Monomorium pharaonis*). The common yellowish red ant about 3-16 inch long that frequents houses in such numbers at times.

Treatment: destroy colony with carbon bisulfid when possible. Attract to sponge filled with sweetened water and kill the collected ants by dropping them in hot water.

69 **Bacon beetle** (*Dermestes lardarius*). Dark brownish beetle about 5-16 inch long with yellowish band on wing covers. Larva brown, hairy, about ⅝ inch long. Both adult and larva attack bacon, meat, etc.

Treatment: cleanliness and excluding insects from the food.

70 **Croton bug** (*Phyllodromia germanica*). The smaller, light brown roach about ¾ inch long found in houses.

Treatment: roach poisons, such as Hooper's fatal food. Paris green with sugar has been used successfully, but is a dangerous poison. Fumigate with sulphur where possible. Entice the bugs to enter vessels partly filled with stale beer, from which no escape is provided.

71 **Cockroach** (*Periplaneta orientalis*). The larger, dark brown species, an inch or more long, found in dwellings.

Treatment: same as for the croton bug.

Insects Affecting Stored Grains and Leguminous Seeds.

72 **Grain moth** (*Sitotroga cerealella*). A small caterpillar about 7-16 inch long working in various grains and producing a whitish moth with a wing spread of a little over ½ inch.

Treatment: fumigate infested grain with carbon bisulfid.

73 **Saw toothed grain beetle** (*Silvanus surinamensis*). A small, brown slender, beetle about ⅛ inch long found infesting cereals and dried food products.

Treatment: fumigate infested cereals with carbon bisulfid and allow none of its food to lie long undisturbed.

74 **Indian meal moth** (*Plodia interpunctella*). Whitish caterpillar living in Indian meal and other cereals and fastening the particles of grain together with a web. Moth with the outer two thirds of fore wings reddish brown, the inner portion and hind wings light gray.

Treatment: fumigate infested food with carbon bisulfid.

75 **Confused flour beetle** (*Tribolium confusum*). A rather stout, shining, reddish brown beetle about 3-16 inch long. Very prolific and frequently causes considerable injury.

Treatment: fumigate with carbon bisulfid and clean infested localities.

76 **Bean weevil** (*Bruchus obtectus*). Small, grayish brown beetles about ⅛ inch long breeding in dry beans and eating out numerous holes.

Treatment: fumigate beans in all infested localities with carbon bisulfid as soon as threshed.

77 **Pea weevil** (*Bruchus pisorum*). Brownish or black beetles with indistinct white markings, about 3-16 inch long, infesting peas.

Treatment: same as for bean weevil.

Beneficial Insects.

78 **Silkworm** (*Bombyx mori*). Showing eggs, larva, single and double cocoons, those from which moths have emerged, one from which the silk has been reeled, male and female moths, raw silk; also several other species of silk-producing moths.

79 **Pollen carriers.** A great many insects convey pollen from flower to flower and in certain cases there are some very interesting adaptations. Some of the more common pollen carriers are honey bees, bumble or humble bees, other bees, wasps, flower of Syrpbus flies and many others.

80 **Lady bugs.** Certain species are valuable agents in controlling plant lice, which they and their young feed on. Some forms prey on scale insects.

81 **Soldier beetles** (*Chauliognathus* species). The beetles are among the pollen carriers and the grubs prey on the larvæ of the codling moth.

82 **Syrphus flies.** The adults are usually seen among flowers but the work of their frequently brightly colored larvæ in reducing the number of plant lice is not so well known. These beneficial maggots are nearly conical and may be found among colonies of plant life.

83 **Spined soldier bug** (*Podisus spinosus*). Represents a number of species which prey on other insects. This one feeds on various common pests, such as the potato beetle, elm leaf beetle and asparagus beetle grubs.

84 **Red tailed Tachina fly** (*Winthemia 4-pustulata*). Valuable parasite of army worm, tent caterpillar and several other pests.

FORMULAS.

Internal poisons like paris green are used only against insects which devour their food. Place where they must be eaten if the plant is attacked and on nothing soon to be used for food.

Paris green 1 lb., lime 1 lb., water 100-300 gal., or dry 1 lb. to 75 of plaster or flour. *London purple* and *paragrene* may be used in the same manner.

Arsenite of lime. Dissolve 1 lb. white arsenic, 4 lb. sal soda (washing soda, carb. soda) in 1 gallon water by boiling in iron vessel 15 minutes, or till arsenic dissolves, leaving only a little muddy sediment. Add water lost in boiling, use 1 pint of this solution to 40 gallons water, to which have been added 2 lb. freshly slacked lime, or add 1 pint of the solution to 40 gallons bordeaux mixture.

Arsenate of lead. Dissolve 11 oz. acetate of lead (sugar of lead) in 4 quarts of water and 4 oz. arsenate soda (50 per cent. purity) in 2 quarts water, each lot in a wooden pail, then add solutions to 100-150 gallons water. May be used much stronger without injury to plants. Very good paste forms are now on the market.

Poisoned baits. Dip fresh clover or other attractive leaves in strongly poisoned water, placed in infested localities. One lb. paris green, 50 lb. bran, sweetened with molasses or cheap, sugar, mixed to a soft mash with water is good for grasshoppers; 20 lb. dry middlings, 1 lb. paris green, is good for cutworms.

Poison carrier.[1] Heat 1 pint fish oil or cheap animal oil except tallow, 5 lb. pulv. resin in iron kettle with 1 gallon water till resin softens; then add lye solution (1 lb. concentrated lye dissolved as for soap); stir thoroughly; add 4 gallons water and boil two hours, or till mixture will unite with cold water, making a clear, amber colored liquid. Add water to make 5 gallons. Use 1 gallon of the solution to 16 gallons water and add 3 gallons milk of lime and ¼ lb. paris green.

[1] Recommended by Mr. Sirrine for holding poison on cabbage.

Contact insecticides are effectual only when applied directly to soft bodied insects.

Hellebore (fresh) 1 oz., water 3 gallons. May also be applied dry.

Pyrethrum or *insect powder* (fresh), 1 oz., water 3 gallons.

Kerosene emulsion. Hard soap ½ lb., boiling water 1 gallon, kerosene 2 gallons, dissolve soap in water, add kerosene and emulsify. Or, for limestone regions, 2 gallons kerosene, 1 gallon sour milk, emulsify. Dilute 4-25 times before using.

Crude petroleum. A 20 per cent. mechanical emulsion has proved of great value against San José scale when applied just before the buds opened, and the trees were unharmed.

Whale oil soap. 1½ to 2 lb. to 1 gallon water for winter use; for summer use, 1 lb. to at least 4 gallons water.

Ivory soap. Five-cent cake to 8 gallons water.

Hot water, tobacco in solution or as dust are valuable contact insecticides.

Washes for borers. One pint crude carbolic acid (½ pint refined), 1 gallon soft soap, thin with 1 gallon hot water, stir in acid, let it set over night, then ald 8 gallons soft water. Or to a saturated solution of washing soda add soft soap to make a thick paint; this is improved by 1 pint crude carbolic acid and ½ lb. paris green to 10 gallons of wash. Or in 6 gallons saturated solution of washing soda, dissolve 1 gallon soft soap. add 1 pint carbolic acid, mix thoroughly, slake enough lime in 4 gallons water, so that when added, a thick whitewash will result, then add ½ lb. paris green, mix thoroughly. The latter is probably the best. Valuable only to prevent egg laying on bark.

Fumigation. Most valuable for young nursery stock and for grains. Cyanide of potassium (98 per cent. pure) 1 oz., best grade commercial sulphuric acid, 1 oz. by measure, water 3 oz. by measure, these amounts for 154 cubic feet space, expose trees at least one-half hour. Prepare tight chamber, mix acid in water by pouring acid slowly, stirring frequently, into the water. Use earthen or glass vessels, and drop cyanide into the diluted acid, closing chamber at once.

Carbon bisulfid 1 lb. to 1,000 cubic feet space, place in shallow dishes near *top* of chamber.

These substances are deadly poisons, the acid will corrode or eat many things, carbon bisulfid is inflammable and explosive in the presence of *any fire. Handle all with extreme care.*

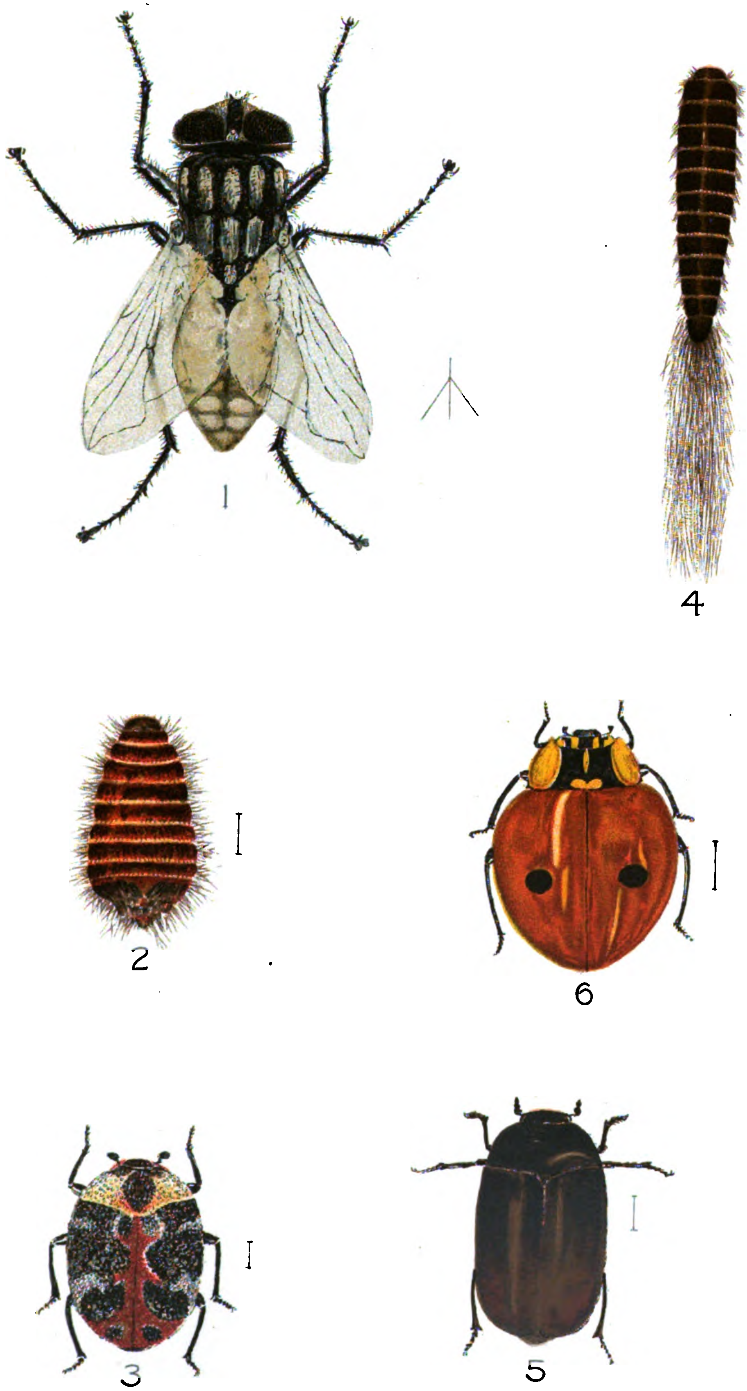
Household Insects.

By Dr. E. P. Felt, New York State Entomologist.

Country houses are the pleasantest on the face of the earth. The person dependent for a living on the profits obtained from the farm may not have a residence quite equal in some respects to the country houses of the wealthy, yet there is no reason why it should not be clean, comfortable and a very enjoyable spot. Such, I am glad to state, is the condition of many farm houses. The presence of almost any insect in the home is troublesome to the housewife and frequently to other members of the family, and when any one species occurs in large numbers, comfort is seriously marred. The farm house is usually distant enough from others so that there is little danger of neighbors supplying us with household pests, and even the greater portion of the house flies probably have origin on our own farms. A serious disadvantage in city life is the closeness of houses one to another. Almost all kinds of household pests have no difficulty in passing from one to another, while a nearby stable may produce enough flies to supply the entire neighborhood. There is hardly any excuse for such conditions existing in the country, and yet I have been in places where one might almost suppose the house was built to accommodate the flies. They certainly took possession of everything.

Mosquitoes.—A large proportion of farm houses are more or less troubled with these tiny pests. We all know that they can be excluded by the use of screens at doors and windows. Is it not practicable sometimes to go behind this and prevent their production? It is well known that mosquitoes breed in pools and some may have seen the black or dark colored, boat-shaped egg masses floating on the water. In about sixteen hours the

PLATE 5



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eggs hatch and the young wrigglers begin their active life in the water, and then require only about seven or eight days to complete their growth. Next they change to the curious pupa and about two days later the perfect insect emerges. It requires but 10 to 15 days for this insect to complete its life cycle, and the short time necessary for this explains the production of enormous swarms of these winged pests as the season advances, specially when it is remembered that each female may produce from 200 to 400 eggs. Mosquitoes breed, as most of us know, in comparatively still water, and in many places areas of this kind are somewhat limited or else can be reduced materially without much trouble. In many cases the supply of mosquitoes may come from a water barrel just outside the door or from near by pools. If not practicable to do away with these by drainage, it is still possible to prevent to a large extent the production of the insects. The experiments conducted by Dr. L. O. Howard, chief of the Division of Entomology of the United States Department of Agriculture, have shown that kerosene applied at the rate of one ounce to every 15 square feet of surface and renewed monthly is a most efficient preventive of the breeding of mosquitoes, and one that is practicable when the area of still water is somewhat limited, as is the case in many localities. Kerosene can be applied to tanks or cisterns containing drinking water without unpleasant results, provided the water is drawn through a pipe from below the surface. This method is at least worthy a trial in many places. Kerosene applied in like manner to pools frequented by gad or horse flies has resulted in the destruction of many of these annoying pests, and a trial of it is recommended.

House Fly.—This is one of our commonest pests (plate 5, figure 1) and its presence in large numbers in the home has too often been taken as a matter of course and no attempt made to mitigate the trouble. We all know that the flies can be excluded from a house to a great extent by the use of screens, but if the creatures can be prevented largely from multiplying, the evil is stopped at its source. It has been found that our common house fly breeds in large numbers in horse manure and also to some extent

in dooryard filth, but the former substance appears to be preferred by this pest. One fly can deposit about 120 eggs which hatch in approximately eight hours. The maggots grow rapidly and in about ten days transform to adult flies. The short life cycle and prolificacy of this insect account most fully for its enormous numbers in hot weather.

In many places it would appear that comparatively little effort would prevent the breeding of the flies to a considerable extent. Either the manure could be spread on the fields daily, as recommended by advanced agriculturists, or a dark shed or cellar could be provided for its reception. The first method would result in such rapid drying of the manure that the flies could not mature. It is not usually very much trouble to inclose a shed or cellar so it will be too dark for the flies to enter, and this plan would therefore result in reducing the numbers of the pests very greatly. With the manure properly cared for and out of reach of flies, and a little cleaning up of other places offering favorable conditions for multiplication of these insects, the fly nuisance would be abated to a very great extent.

Fleas.—It occasionally happens that a shed or room in a house becomes infested with these pests. They most likely owe their introduction to the pet dog or cat. The eggs of this insect are deposited among the hairs of its host, but not fastened, so they soon drop to the ground and naturally are most abundant about the sleeping place of the animal. The young emerge from the eggs in about one day, and live in dust and refuse occurring on the floor or in crevices. They require seven to fourteen days to complete their growth, then spin a slight cocoon, and about five days later the jumping adults come forth.

The young do not develop successfully in places where they are frequently disturbed, and the necessary lack of sweeping when a house is closed for the summer is probably the cause of the rather frequent reports of such dwellings being overrun with these pests when the family returns. On general principles it may be assumed that the presence of this pest in numbers indicates some favorable, undisturbed breeding place in the im-

mediate vicinity. Frequent brushing and cleaning, supplemented in some instances by the use of fresh pyrethrum powder, benzine, kerosene emulsion or other contact insecticide, will soon stop the breeding of these pests, but may not kill the adults as they are quite resistant to such substances. Where practicable, the adult fleas may be reached by fumigation with sulphur or hydrocyanic acid gas. The latter is very dangerous and the greatest care should be exercised when it is employed.

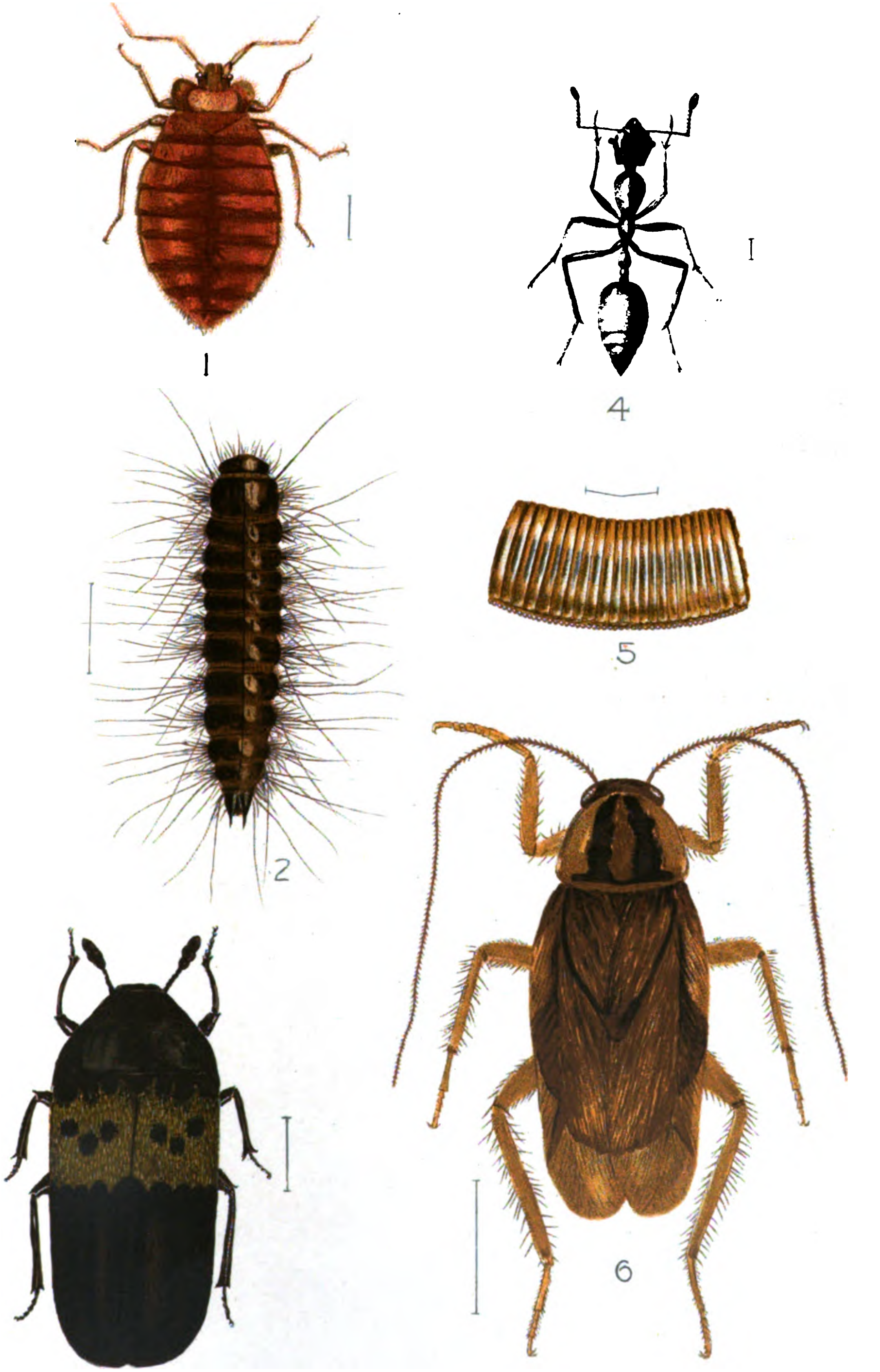
Carpet Beetles and Clothes Moths.—There are two species of carpet beetles commonly found in houses, the Buffalo carpet beetle, *Anthrenus scrophulariæ*, and the black carpet beetle, *Attagenus piceus*. The hairy, shaggy larva (plate 5, figure 2) of the former species is pretty well known to the housewife. The parent insect is a small oval beetle about one-eighth of an inch long and prettily marked with red and white on a black background, as represented at figure 3, plate 5. The larva of the black carpet beetle is easily recognized by its slender form and tail of long hairs, plate 5, figure 4. The parent insect is similar in shape to the preceding species, but is a dark brown or black, plate 5, figure 5. The artist has also represented a two-spotted lady beetle (plate 5, figure 6), an insect which is frequently taken for a carpet beetle. This pretty lady beetle and others of its kind are beneficial and should be protected. If they can be recognized in no other way, remember that the under side of the lady beetle is nearly flat, while both carpet beetles are very convex and hence will readily rock when placed right side up on a level object, unless their legs are extended.

Before passing to a consideration of remedies, the clothes moths will be briefly noticed. There are several species attacking clothes. Their work is familiar to almost everybody and in a badly infested house it is by no means uncommon to see the delicate moths flying about the rooms. The larvæ, as is well known, show a marked preference for woolen and fur goods.

The young of all these insects do not like light, air and disturbance. Hence one of the best protective measures, particularly for garments, is brushing and airing from time to time,

specially in the summer months. It is usually more satisfactory to take up badly infested carpets, beat and air them thoroughly and, in cases of a bad infestation, spray them with benzine. The room should be thoroughly cleaned and if there are cracks in the floor, it is advisable to fill them with plaster of paris. As a further preventive, the carpet may be laid on tarred paper or else replaced with rugs. Clothes or other articles put away for the summer can be protected in the following manner: Brush well so as to be sure no eggs or larvæ adhere and then lay away in large pasteboard boxes, such as may be procured at a dry goods store, put in some napthaline balls, camphor or similar substance and then seal the cover with a strip of gummed paper. The boxes cost little and if the work is thoroughly done there is no danger of injury by these pests. This method is one recommended by Dr. Howard. He has also found that these insects are not active at a temperature lower than 42° F, and hence storage of valuable furs, etc., at a lower temperature than this may be considered a safe and practical method of preserving them from insect injury.

House Ants.—Several species annoy the housekeeper very much at times. The worst of them all, where it occurs, is the little red ant, *Monomorium pharaonis*, an insect so small that it can hardly be excluded from any vessel. It is represented much enlarged at figure 4, plate 6. As is well known, ants live in nests in soil and not infrequently they establish themselves in underpinning or walls of houses. Whenever possible, seek out the nest and destroy the occupants by a liberal use of boiling water, kerosene emulsion, or strong soapsuds. More effective than these substances is carbon bisulfid, which may be used in the following manner: With a broomstick or bar make some holes in the nest several inches from each other and a few inches deep, pour in each about a teaspoonful of carbon bisulfid, cover the nest with a wet blanket and after a few minutes explode the fumes collected underneath with a match on the end of a short stick. Unfortunately, it is not often possible to get at the insects in their nests and then we must resort to the laborious trapping with a sponge moistened with sweetened water and dropping the collected pests



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Household Insects

into boiling water. Lard or fat may be used as a bait and then burned after it has become well covered with the insects. A syrup made by dissolving borax and sugar in boiling water is said to destroy ants in large numbers. This should be preceded when practicable by the removal of other attracting substances. The above measures would prove of value in case of infestation by other species of ants.

Cockroaches.—There are two species commonly found in houses, particularly in cities, the smaller, light brown croton bug, represented at figure 6, plate 6, and the larger brown or black cockroach. The egg capsule of the former is shown at figure 5 of plate 6. Both species prefer the vicinity of water pipes, sinks, etc., and if abundant anywhere in a house are to be found somewhere about the kitchen. They subsist on almost any article of food, but it is not so much what they devour as their disgusting odor, etc., that render them objects of abhorrence to the housewife. The croton bug is more wary than the other species, which latter can be enticed to vessels of stale beer and if sticks be arranged so the creatures can easily get over the perpendicular sides of the vessel and be obliged to drop a little distance in order to get at the liquid, many can be trapped in that manner. Sugar and paris green well mixed and placed about their haunts will soon diminish their numbers greatly, but paris green is a dangerous poison and can not be used with safety where there are children. Hooper's fatal food is said to be nonpoisonous and it has proved itself thoroughly effective in a number of places. Prof. J. G. O. Tepper, Adelaide, South Australia, recommends a mixture of one part of plaster of paris and three parts of flour, with water near by. The roaches are said to eat the mixture, drink the water and die in a short time. The insects are said to disappear in a few weeks. This is not expensive and is certainly worthy a trial.

Bedbug.—It is almost impossible to prevent one of these creatures from occasionally making its way into the home, particularly is this true where many guests are entertained or members of the family travel to a considerable extent. Once in a while a

family is so unfortunate as to move unwittingly into a house infested with this pest. The insect, represented much enlarged at figure 1, plate 6, has probably a slight acquaintance with most of us. The white, oval eggs are laid in batches of from six to fifty in cracks and crevices, as stated by Dr. Howard. They require from seven to ten days to hatch and the life cycle is completed in about eleven weeks.

The use of iron or brass bedsteads is to be recommended because they afford so little shelter to the pests. Where large wooden bedsteads are used, the crevices should be liberally treated with benzine, kerosene or corrosive sublimate solution. Hot water, where it can be employed without injury, will kill eggs and bugs. This treatment must be supplemented by daily inspections and the destruction of all specimens found. Fumigation with sulphur is reported by some as effective, but others state that it has no value. Treatment with hydrocyanic acid gas would probably be very effective, but it must be used with great care, and there is danger of killing mice and rats in the walls or under the floors and the resulting annoyance. Though red ants are household pests, they are said to wage warfare on bedbugs. The cockroach is also credited with the same useful habit, but unfortunately neither of these species can be considered desirable acquisitions from the housekeeper's standpoint.

Larder Beetle.—The larva and the adult are represented on plate 6, figures 2, 3. This insect occurs in museums and attacks many animal products like hams, bacon, other meats, horn, hoofs, skins, beeswax, etc About six weeks are required to complete the life cycle under favorable conditions The contents of infested rooms should be cleared out and the room fumigated with carbon bisulfied or hydrocyanic acid gas. Infested portions of meats should be cut away and the surface of the remainder washed with a diluted solution of carbolic acid. The parent insect can be excluded from a store-room by the use of screens.

Cheese Skipper; Ham Skipper.—The insect is well-known to many in the larval or skipper form though few may be acquainted with the parent fly. This insect is usually found in the best

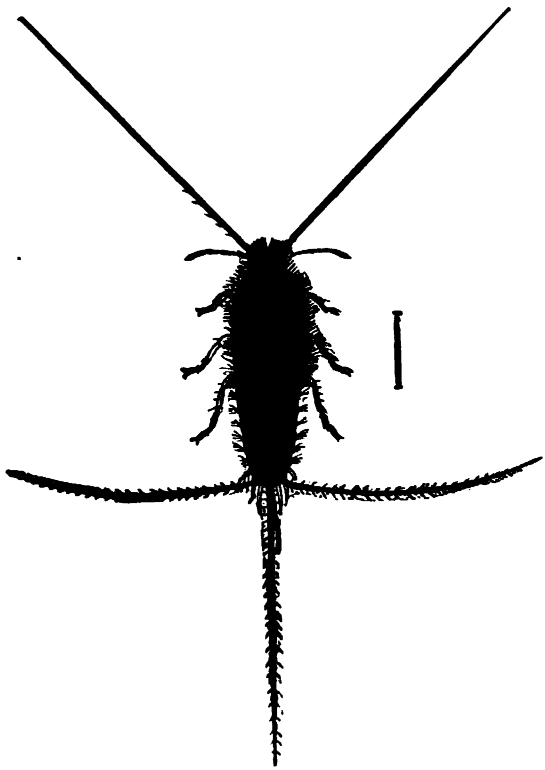

FIG. 5—*Lepisma Domestica* (After Marlatt: U. S. Dep't Agricultur
Division Entomology, Bulletin 4).

Explanation of Plates.*

PLATE 1. APPLE TENT CATERPILLAR (*Clisiocampa americana*).

Fig. 1. Eggs, enlarged.
Fig. 2. Dorsal view of caterpillar, enlarged.
Fig. 3. Nest of partly grown caterpillars, reduced.
Fig. 4. Cocoon, much enlarged.
Fig. 5. Moth, enlarged.
Fig. 6. Cocoons in fence corner.

PLATE 2. FOREST TENT CATERPILLAR (*Clisiocampa disstria*).

Fig. 1. Eggs, enlarged.
Fig. 2. Dorsal view of caterpillar, enlarged.
Fig. 3. Pupa, enlarged.
Fig. 4. Cocoons within maple leaf, reduced.
Fig. 5. Moth, enlarged.

PLATE 3. CODLING MOTH (*Carpocapsa pomonella*).

Fig. 1. Apple showing work of larva, natural size.
Fig. 2. Hibernating cocoon of larva under a piece of bark, enlarged.
Fig. 3. Moth at rest, very much enlarged.
Fig. 4. Moth with wings spread, very much enlarged.

PLATE 4. CODLING MOTH.

Fig. 1. Larva, very much enlarged.
Fig. 2. Pupal case, very much enlarged.
Fig. 3. Apples just right to spray, slightly reduced, note open calyx lobes.
Fig. 4. Too late to spray, slightly reduced, observe the closed calyx lobes.

PLATE 5. HOUSE FLY AND CARPET BEETLES.

Fig. 1. House fly (*Musca domestica*), very much enlarged.
Fig. 2. Larva of Buffalo carpet beetle (*Anthrenus scrophulariae*),
Fig. 3. Adult of same, very much enlarged.

*Drawn and colored from nature under the author's direction by Mr. C. S. Banks.

Fig. 4. Larva of black carpet beetle (*Attagenus piceus*), very much enlarged.

Fig. 5. Adult of same, very much enlarged.

Fig. 6. Two spotted lady bug (*Adalia bipunctata*), very much enlarged.

PLATE 6. HOUSEHOLD INSECTS.

Fig. 1. Bed bug (*Acanthia lectularia*), very much enlarged.

Fig. 2. Larva of bacon beetle (*Dermestes lardarius*), very much enlarged.

Fig. 3. Adult of same, very much enlarged.

Fig. 4. Little red ant (*Monomorium pharaonis*), very much enlarged.

Fig. 5. Egg mass of Croton bug (*Phoyllodromia germanica*), very much enlarged.

Fig. 6. Croton bug, very much enlarged.

Tile Drainage.*

By H. E. NICOLAI of Big Bend, Wis.

To lay down a specific rule of tiling would be an impossibility for any one, as different lands and conditions would vary the cost of drainage both as to the number of drains required, the amount of labor expended in digging, and also the size of the tiles used.

Different Treatment for Different Lands.

I have one piece of border land containing fifteen acres, in which the drains are from four to five rods apart, and the drainage is perfect, while in another piece of only half the size, the drains were put four rods apart and proved to be insufficient to drain the land thoroughly. The former piece is a black sand loam, underlaid with sand and clay, while the latter was a boggy marsh, full of small springs. The top soil was muck, underlaid with clay and gravel. The drains had to be doubled wherever the ground was springy, making them only two rods apart, and the depth of the tiles is about four feet. The cost of this piece was about $30 per acre, while the former was only $10 per acre. Both pieces have been in cultivation ever since they were drained, about ten years ago, and have produced wonderful crops. The average cost per acre of tiling a wet marsh is about $20.

The most profit in tile draining is derived in fields that have small basins in them on the elevated parts of the fields, which fill with water during the spring and keep the lower levels of the fields wet and cold until the water evaporates in the basins. One drain with a few laterals in the basin will usually be enough

*A paper read before a farmers' institute in Wisconsin and the discussion following.

in fields of this kind, and the cost will be very small when compared with the benefits derived from them.

The benefits to be derived from the drainage depend largely on the location, the value of the land, and what crop the land is used for. As no two fields present the same condition, except level marshes, one must rely upon his own judgment, according to the condition and location of the land.

How to Tile Drain.

First ascertain how much fall there is in the land to be tiled, from the upper end to the outlet. If there is a gradual fall from source to outlet, no survey is necessary, but if the land is nearly level, or if there are any depressions or basins, so that it is hard to determine the amount of fall, obtain the services of a competent engineer to determine the fall from the upper end of the outlet. The fall should be divided up by setting stakes every hundred feet and drawing a level line from these stakes. The stakes should be driven close to one side of where the ditch is to be dug. The fall can then be divided by measuring from the line to the bottom of the ditch. From one-fourth to one-half inch of fall to the rod is enough, and in large tiles less fall will do.

Digging the Ditch.

Commence at the outlet to dig the ditch. If the banks of the ditch have a tendency to cave, the tiles should be put in as fast as the ditch is dug; but if the banks stand firm, it is better to commence laying the tiles at the upper end, after the whole ditch is completed. The lower part of the ditch should be dug with a tile spade, the bottom cleaned out with a tile scoop, and the tiles laid with a tile hook.

The tiles should be covered with loose soil to the depth of twelve inches. This can be done by breaking down the top of the bank on both sides of the ditch, after which the filling of the ditch can be done with the horses and plow, care being taken not to let the horses get into the ditch and disturb the tiles.

Cost of Tiling.

I will give you a description of a piece of land which I tiled eleven years ago, and also the expense of tiling it at that time. The piece in question consisted of about an acre, covered with water the greater part of the time. Surrounding this water were about four acres of land grown to willows and rushes, also under water during wet seasons. Surrounding this last strip are about four acres of what is usually known as border land (too wet to plow and not wet enough to be called marsh), making about nine acres in all. It was worth, for grazing purposes, at the outside figures, not more than $40 per acre. The expense for draining it was as follows:

2,960 2½-inch tiles at $10 per M	$29 60
1,136 3-inch tiles, at $12.50 per M	14 20
432 4-inch tiles, at $16 per M	6 91
512 6-inch tiles, at $25 per M	12 80
Total	$63 51
10 per cent. discount for cash	6 35
Leaving total amount paid for tiles	$57 16
315 rods of ditch, at 30c. per rod	94 54
Hauling tiles from factory	15 00
For making dike and open ditch	10 00
Total cost for 9 acres	$176 66
Cost for one acre	19 62

This land, worth $40 per acre, and costing $19.62 per acre for draining, cost $59.62 per acre. The real value of the land now is $100 per acre.

This basin was the receptacle of a great deal of surface water from a neighbor's farm, and, to prevent it from being flooded during the heavy rains, I dug an open ditch on the upper side to a point beyond the natural outlet of the basin, putting the earth

from the ditch on the lower side for a dike. It requires a little repairing every spring, but aside from that it has worked to perfection.

The crops raised on this piece of land the past few years have been the admiration of the whole neighborhood. The crop this last year was a fair yield of early Ohio potatoes, followed by a heavy crop of fodder corn, which, in turn, was followed by winter wheat. At the first of the year the wheat was in good condition, but of course it is now killed, owing to the severe winter.

Another Experiment.

My last experiment was on fifteen acres of border land along the Fox river. It was too low to admit of any fall to the river except when the river was very low. I dug an open ditch, six feet wide at the top, two feet at the bottom and three feet deep, along the lower side of the piece to be drained, to receive the water from the tile drains. The earth was all put on the river side of the ditch for a dike, to prevent the water overflowing the land in case of high water. I also dug an open ditch from the river to the dike, connecting it with the first open ditch by means of a flume, which passes under the dike and can be opened or closed, as the case may require. When the river is low, I keep the flume open; when it rises so as to set back into the open ditch, I close the flume to prevent its filling the ditch, and what water collects in the ditch can be pumped out over the dike.

In this way any level marsh can be reclaimed, and it need not cost more than $25 per acre. The larger the piece drained, the less the expense per acre for diking and pumping. The following hints will be useful to those inexperienced in tiling.

Practical Suggestions.

First, get the fall of the land, and then lay the drains in a systematic way. Never lay the tiles less than three feet deep; four feet is better. If tiling is let by the job see to it that it is done according to agreement, and always inspect the work before the tiles are covered.

Put a wooden box at the end of each tile drain where it discharges into an open ditch, but have as few open ditches as possible.

Use 2½-inch tiles in all laterals for the first six or eight rods, and for a longer distance, if there be plenty of fall. Half an inch of fall to the rod in the laterals, and one-quarter of an inch in the main ditch, is sufficient, although more fall would be better, as smaller tiles could be used. The main ditch should be dug a little deeper than the laterals, so as to join the laterals near the upper side of the tiles in the main ditch.

Later Treatment.

If your land should not produce anything the first or second year, do not get discouraged, but give it a coat of wood ashes or barnyard manure, and you will be astonished to see what crops it will produce.

If your drain will discharge its water on a neighbor's land below you, get his consent first, as you have no right to flow any more water on his land than there is naturally flowing over the surface. Remember this fact will save hard feelings, and sometimes a lawsuit.

Discussion.

Question.—How do you pump at that place?

Mr. Nicolai.—I have a tread power, but the seasons have been so dry and there is so little surface water falls on the land that there are very few seasons that you need to pump; in fact, I have never had any pumping to do since the first year that I put in the tile, and I have taken out the pump and used it for other purposes. When you have to do permanent pumping, a good large wind-mill, or two of them, would be the cheapest.

The Chairman.—I did some tile draining on my farm about fourteen years ago, I think. When I commenced working at it, a neighbor was going by, and he says: "What are you doing?" I answered: "I am putting some tile drains in the ground." And he says: "That costs money. If you have money so plenty that you can afford to bury it in the ground, you better let me have

it; I can make good use of it." But the next year and the next year after, when he went by there and found magnificent crops of corn, such as he had never seen on my farm before, he went to tiling, and he has buried four times as much money as I did.

Mr. Briggs.—In a very heavy clay soil, how close together would you have to put the tile, and how deep?

Mr. Nicolai.—Where it is very stiff clay I would put the tile down two rods apart and four feet deep, if you can get them down so deep—if they have fall enough.

Mr. Briggs.—Will the water ever soak down to them?

Mr. Nicolai.—Yes, if they are covered with loose soil first.

Q.—Don't you put something over before you put on the loose soil?

Mr. Nicolai.—No. If it is quicksand, I put marsh hay or straw over it, simply to keep the sand from coming in after I have covered it. Quicksand won't run unless there is some water. I have taken up tiles that were laid in quicksand when I put them in trenches where it was too wet, and in all the tiles I have taken up I never found a tile filled with sand. If they are laid properly, so there is a gradual fall, what little sediment runs in at the joints the water will continually carry out at the outlet.

Q.—Suppose the land is blue clay. Would you put the tile down four feet?

Mr. Nicolai.—No, I don't think it would be any advantage.

Mr. Arnold.—It would not be worth draining if it were blue clay, would it?

The Chairman.—Yes, it would. I know of some land that is blue clay land with a little black soil on top of it.

Mr. Nicolai.—I would take that little black soil and shove it down on top of the tile and fill the trench up with mixed blue clay and black soil; that will drain it off in good shape. It is the black soil that furnishes the good drainage above the tile.

The Chairman.—Many people are skeptical about this thing, just as I was. I had read a great deal about tile draining, about

how much good it would do to land, and when I commenced digging a ditch through some blue clay, I said: "I don't see how it is possible for the water to get through that. It is no use; it can't draw from each side." But it did; but not until the ground had once been frozen, and after it had been frozen twice, it did still better. I looked at it like this, that the land is not so impervious but that it gets full of water, and when it freezes it expands. It commences to thaw out from below, making little channels through the clay, and the clay being released, it doesn't pack down so solid as it did before, so it is much better each year.

Q.—Do you understand that the soil thaws out from underneath?

The Chairman.—Yes, sir.

Mr. Nicolai.—It thaws out from both sides. But I will give another explanation in regard to loosening the clay soil. You all know that angleworms will not work in water, but just as soon as you dry out the water, and give them a chance, they will work over the soil to the depth of the water, and in that way I think the clay soil is helped very much.

Mr. Wing.—I am glad to hear you speak of the angleworm, because we have what we call exhausted soils in Ohio. They have become tough and hard, and in those soils the angleworm helps us after we have put on some manure. Of course, we do not find them in the clay, but after the manure is put on, the humus gets down, and they work through.

Q.—Do you think there is any truth in the theory that high, gravelly ground can be benefited by drainage in dry seasons?

Mr. Nicolai.—It depends on what your high ground is. In land where the surface soil is underlaid with sand or gravel, as natural drainage, you cannot benefit by tiling, but heavy clay soil can be benefited by drainage. It depends on where your land is located, what the value of it is, etc., as to whether it is profitable.

Mr. Wing.—Would you think it necessary to give a quarter of an inch fall to the rod, if you don't have that much?

Mr. Nicolai.—No, I stated that less fall may do.

The Chairman.—One inch to the hundred feet will do, if you have fine work enough.

Mr. Arnold.—In tiling, will the siphon principle work—is it tight enough?

Mr. Nicolai.—Yes, in clay land, you can get it tight enough to draw out water, but it won't do you any good. You let in the air, and it will spoil your crop before you can get the water out. I have seen it worked in tiling with clay.

Q.—Didn't you find it essential to lay the tile so that there will not be any depression where the water will fill up?

Mr. Nicolai.—I never laid any where I had depression in the tile.

Mr. Wing.—In Ohio, when we trusted to the colored brother to lay tile, he would have a low place in the ditch and the water would stand clear up; if you don't see it in time you will have to dig it out. It does not hurt so much where there is a strong current, but where there is just a little shower that will carry in a little earth, after a while it will harden there and fill it up.

The Chairman.—You don't want any willow, cottonwood or elm trees growing near your tile. They will get in through the small openings and obstruct it.

Mr. Nicolai.—Hadn't you better include all trees?

The Chairman.—Maybe, but oak won't bother.

Mr. Arnold.—Is not underdraining just as good where it is made out of stone as out of tile?

Mr. Nicolai.—Yes, but it is a great deal more expensive. The first drainage I did was of stone, and it cost me about a dollar a rod, but it was done in good workmanlike manner, so it is a good drain to-day, and I think it was put in eighteen years ago; before we had any tile factories in our section.

Mr. Wing.—Hasn't that drain got lots of fall?

Mr. Nicolai.—No, it has no more fall than my tile. I don't think more than half an inch to the rod, and some places not that much, but I can tell you how I put it in. It was a low,

boggy marsh; I dug a ditch four feet deep and a little over a foot wide at the bottom, so that I could get two good-sized stones, one on each side; then I covered it with large stones on top, and filled it with gravel, chinking it on the sides for about a foot, making it tight; then I used boards in the bottom to put my stones on, so they would not slip in the mud, and after the water got thawed, it run a nice stream of water. During the dry season this winter it has run a nice stream of water.

Supt. McKerrow.—Do your tiles run water in cold weather?

Mr. Nicolai.—Yes, sir; most of my tiles are running water now. Of course, most of my ground is springy. On most land there is no water to run only in the spring of the year.

The Chairman.—Now we will suppose there is some marsh land running by the side of the hill (highland), and we know that along next to the highland the marsh is apt to be the wettest. Now, how would you run your tile—parallel with one side of the hill, or run it right down through the marsh to the creek, forty rods from there?

Mr. Nicolai.—I would run it parallel with the hill.

The Chairman.—That is the way I did, and it dried the land for twenty rods beyond it; just cut off that spring water.

Mr. Nicolai.—Springs are frequently cut off in that way, and it will save a great deal of tile. It will make dry land out of small fields which are kept wet by the seepage of these springs over the land.

The Chairman.—I want to say, just as Mr. Nicolai did, that if it is going to cost more to tile the land than the land is worth, of course it won't pay to tile it, but even in such cases a man may have a wee spring running diagonally through a field, and it may pay him a great profit to tile it. That was some of the first work I did. I had a field of twenty acres that was cut in two diagonally by a spring, resulting in all five acres of wet land. I run a tile through the whole field, so I could plow it. It worked splendidly, and after one has commenced to tile such places as that, he will see other places, and he will keep on until he makes a garden of his whole farm.

Mr. Nicolai.—I have had the same experience as Mr. Goodrich, in regard to my neighbors accusing me of throwing away my money; also in regard to the fact that after I commenced to tile I did not stop until every foot of my land that needed it was tiled. I have tiled about sixty acres now, and I have noticed that all the men in our section, after they have once commenced it, can not find a stopping place until every foot is dry, and that is very good evidence that it pays.

Mr. Wing.—I have a neighbor who began laying tiles, and his father thought he was crazy. He came out from town afterwards and saw the crop of clover and the wheat growing on the land, and he turned the tables on the boy. He says, "Joe, this ought to have been done long ago."

Mr. Nicolai.—There is one very great advantage with tiled land, and that is its early use in the spring. I notice that my tiled land is ready to work a great deal sooner than ordinary upland, because the tile is at work all winter where there is no frost underneath, and just as quick as the frost is out, your land is dry and you can go right to work on it and put in your crop.

Mr. Arnold.—Have you ever had the water analyzed from these drains to find out whether it is taking off any fertility or not?

Mr. Nicolai.—I never have, but I am convinced that it does, in certain cases.

Mr. Arnold.—How would you stop that?

Mr. Nicolai.—I don't know that I could stop it, nor could I stop losing some of the fertility under any circumstances. I am one of those who believe in manuring in the fall or winter, or any other time that it is convenient, to get it on the land as quickly as possible, spread it on brodcast, and in that condition I am going to lose some of the fertility anyhow.

Mr. Arnold.—Don't you believe if you have a growing crop on the land there would be less loss than without any.

Mr. Nicolai.—There wouldn't any crop grow just now. There is a chance as soon as the water gets out of the land. I know of one place where the basins were all filled up with water two weeks ago, and it has all sunk away, the land is dry, and if there

was any manure scattered on the top and soaked up in the water, some of the fertility is gone; but I would rather lose a portion of it than be compelled to drag out my manure after the frost is out of the ground.

Mr. Throp.—This tile we are talking about is about four feet down in the ground. If there is any fertility in the water that floats on the soil, it is going to be filtered out before it reaches the tile, and be kept in the soil. I have been watching some people in my neighborhood who have been putting in quite a number of thousand feet of tile. Two or three years ago, in fact, one young man put in 20,000 feet at one time, in one season. He hired a lot of men and they came and tile-drained diagonally across eighty acres, which was almost a worthless piece of ground before he began. That slough ran down for miles, and the water came coursing down through there in the spring on each side of the ditch. It was a boggy marsh. Part of it he could mow and part of it he couldn't. He put in 20,000 feet of tile, and the result is that he plows the whole thing now, and those eighty acres are the most valuable he has on his farm. I asked him if he thought he would do any more, and he tells me as soon as he can he is going to tile all his land that needs it. Another man I know, lives along Horicon marsh. The marsh extends in the shape of sloughs around up through his farm. He commenced tiling there, and I guess he will never get done. He manages to get good crops where he does tile; so much better crops than he used to get that he buys his tile by the carload, and his neighbors are following suit and putting in carloads of tile in the same kind of places. So it seems to me that there must be something in it, if we are unfortunate enough to have that kind of land. I am very glad I haven't that kind of land, myself.

There is one point that the gentleman did not touch on, and that is in regard to the water flowing on to the other man's land. You had better get his consent. This last man I spoke of putting in so much tile was troubled with the water in the spring flowing over from his neighbor's land and down through his. He wanted him to go in with him and put in a 10-inch tile through there

for his own benefit. He put a dam across and held the water back on to his neighbor's land, so it couldn't overflow his land, and all the water had to go down through that 10-inch tile, and if there was any surface water he held it back.

Mr. Arnold.—The great German chemist, Liebig, demonstrated, fifty years ago, that if you take liquid manure and run it through the earth covering tiles, that you will have pure water when it goes through. I would not be afraid to tile drain land on account of the loss of fertility, but I think you would lose less if you had a crop growing than without it, according to these experiments.

Good Roads.

By Dr. H. D. Hunt, Marathon, N. Y.

When I was requested to present for your consideration and discussion at this meeting the subject of "good roads," I was very much pleased; not because I felt that I was master of the subject; not because I felt I could tell you all about road building—that is, the material to be used, the manner of using and the cost thereof—but because I considered it an evidence that the farmers of this section were aroused to their importance. I am simply the "old country doctor," and as such have plenty of opportunities to examine the roads, form opinions, and sometimes express them, and I fear they are not always complimentary to the roads, to the road officials, or to the communities through which the roads pass.

How can our highways be improved?

What system of highway improvement should be adopted?

How can the desired end be accomplished?

What will be the cost?

How much will be added to our already heavy burden of taxation?

Will the supervision be a heavy expense?

Will some official receive good pay and have an easy job while we toil and sweat to pay the tax from which he draws his salary?

Can any system be adopted that will give us better roads without increasing taxation beyond our resources?—These and hundreds of other questions at once flash through the mind of the farmer as soon as he contemplates the possibility of having better roads over which to haul his farm products; and the answers that come up in his mind in reply are frequently not such as he most earnestly wishes.

Many years ago I think the farmers used the roads fully as much, in proportion to the population, as they do to-day; I refer to the time when the farmers had to haul their farm products a long way to market. I have frequently heard farmers relate experiences in hauling loads of farm produce from Cortland county to the city of Albany. In those days the roads were full of teams at certain seasons of year, and the roadside inns were taxed to their utmost to accommodate the traveling public. But circumstances wrought a change. By the opening of the canals the markets were brought nearer to the farms, and road travel was much diminished, and circumstances still continued to work to lessen highway travel, and thereby diminish the importance of good roads. Railroads were built traversing the country east and west, north and south, until a market place was established in almost every town. Then at once this (Cortland county) became the great dairy section of the State, and the average farmer could stay at home and work through the entire season, and in the fall load his entire farm product on his wagon and draw it to market at a single load. His necessary use of the roads was very limited, and for a period they were used by him more for pleasure than from necessity. Circumstances continued to exert their influence until to-day a very large number of dairymen draw their products to market—not in one day and at one load, but to the milk station 365 days in a year, and most of the time twice a day. They are now using the roads for something beside pleasure. The farmer of this section has found that he can no longer afford to grow his own grain feed. Cheap transportation that has come hand in hand with the development of the great west has made it possible for him to buy western grain feed cheaper than he can produce it on his own farm, and he now draws many tons of feed from the feed store to his farm.

But a few years ago the markets were calling on the grain producers of New York for a portion of their product, now those markets are supplied by the great west. The western creameries are now supplying the market that but a few years ago

many of the farmers of Cortland county helped to supply, and most of this has been brought about within the last decade. If such great changes have been brought about within that time, changes that have presented to the farmer great obstacles which he has been obliged to meet and surmount, is it not a rational thought that he will have equally great ones to meet in the near future? In view of all these facts, and reasoning from this standpoint, is it any wonder that the farmers are aroused to the necessity of more and better road improvement? But how is this to be accomplished? Certainly the farmers cannot do it all themselves. They cannot assume so heavy a burden of taxation. Then of whom shall they ask assistance? Have they not the moral right to call upon those to whom they have been donating for years? I mean the cities and villages. Who built the cities? Who maintains them? Who furnishes them. their sustenance to-day? The farmer. What has contributed more than any other factor to make New York city the second largest city in the world? There can be but one answer, namely, the Erie canal. Whose money built it? Seventy-five years ago, when the canal was being built, New York city did not pay sixty per cent. of the tax; neither did the canal counties, with their great cities, including New York, pay nearly eighty per cent. of the State tax, as they do to-day. The farmers had to pay largely for the building of the canal, for the enlargement of 1862 and for the maintenance of the canal for many years. But a few years ago nearly one-third of the State tax paid by Cortland county was for canal expenditures, and the advantage that it has been to the canal terminal counties is beyond all mathematical calculation. But what profit has the farmer received? Your profit, if any, has come by such a round-about way, and from so remote a point, that its calculation is scarcely possible and would be more nearly represented by a cipher than any figure. Look at the public buildings that have been built in the cities all over the State at the expense of the taxpayer, either in State or county tax. Are they not a great benefit to the municipalities wherein they are located? Most certainly.

Now I would not have you think that I call your attention to these facts to condemn the canal system of our State, neither would I have you think that I would advocate the erection of our public buildings upon the summit of some barren hill top away from the centers of population, but simply to illustrate the fact that in soliciting help from cities and villages to rebuild and improve country roads, we are but asking for the return of our own. We are not begging, for farmers, above all classes, dislike to beg or be accused of begging.

We have a law called the "Higby-Armstrong Good Roads Law" which provides the the State shall pay one-half the cost of building permanent roads constructed under State supervision. Also the "Fuller Good Roads Law." providingthatany town may draw from the State treasury one-fourth as much money as it will levy and collect by direct tax for road improvement. These laws were passed by a Legislature made up, by a very large majority of representatives from cities and villages, which can rcceive no direct benefit from the operation of these laws. That alone is strong evidence that the cities sympathize with us in our effort to get good roads, and are willing to extend a helping hand. As a further evidence, you are of course, aware that the State Engineer and Surveyor during the last sessions of the boards of supervisors throughout the State, invited each board to send three delegates to a good-roads convention, held at Albany, February 8 and 9, 1900. I had the honor and pleasure of being one of the delegates from this county, and I was surprised to see that the delegates in that convention who lived in cities were the most enthusiastic for improvement of country roads, one gentleman even going so far as to favor the bonding of the State for the enormous sum of $12,000,000 for the improvement of country roads. When a resolution came up petitioning the Legislature for an appropriation of $1,000,000, for the carrying out of the provisions of the "Higby-Armstrong" Law there was not a dissenting voice. All this evidence shows that the cities will aid us if we but ask and give a guarantee that the money appropriated will be faithfully and profitably expended. By a guarantee I do not mean

an indemnifying bond drawn in accordance with the provisions of some man-made law, but a guarantee in accordance with that higher law in which is written: "By their works ye shall know them." Then what work shall we do? What work can we do that will be better than that which we have been doing? Let us see.

We can do as they have done in other counties, organize county good-roads leagues. Through such organizations we can get all the literature on the subject. Each member would thus become familiar with the present laws and from time to time be posted on any proposed new legislation. We would be in touch with like organizations in other counties, thus putting us in communication with all portions of the state. Comparisons of conditions could then be made, which is very necessary, for a law that might be of great benefit to one portion of the State might be of little or no use to another. For instance, the "Higby-Armstrong Law" may be of great advantage in some counties. In a county which contains large cities that pay a large portion of the county tax, it seems clear the advantages would be much greater than they can possibly be to Cortland county. With all counties in communication through County Good Roads Leagues, the wants or wishes of one portion of the State would be known to the other and any proposed legislation might be so framed as to meet the needs of all.

Next let each town adopt the money system as provided by the "Fuller Law." I am happy to say that my own town has done that by a vote of nearly three to one in its favor; yet I do not believe that there are very many of the voters of my town that are fully satisfied with the provisions of the "Fuller Law"; but they seem to reason that it is the best within reach, and certainly a great improvement on the labor system. Under its provisions every man will pay a road tax in proportion to his assessment, and not pay it by sitting under a shade tree by the road side, while his neighbor is shoveling gravel in the sunshine; neighborhood quarrels over highway work will be a thing of the past, and I think all

believe that one dollar in money will purchase labor that will do the roads double the amount of good that one day's work accredited for road work under the labor system has done in the past, and, besides, we have the 25 per cent. from the State in addition. In the convention at Albany, to which I referred, about 80 towns were reported as having adopted the money system and everyone, without exception, found it a great improvement over the labor system.

I believe under the labor tax system the rule is, as generally adopted, to assess one days labor for each $500 assessment, which at commutation rates $2 on a thousand dollars assessment, in round numbers $20,000 in the county of Cortland, dropping the assessment of incorporated villages, would give us $5,000 from the State. Would not, think you, $25,000 a year faithfully and properly expended on the roads of Cortland county make a vast improvement on our roads in a few years? Let us bring the figures down to the town of Marathon. You have an assessment of about $725,000; under the labor system your tax will be 1,450 days, or $1,450, and your poll tax added, would raise the amount of tax to $1,600. Then you would draw from the State $400, thus giving you $2,000, with which to buy highway labor. Does anyone in the county believe that there has been even $1,000 worth of work faithfully and properly performed upon our highways in a year during the last 20 years? If so, you have the banner town of the county, for if you have faithfully and properly expended $20,000 upon your roads in labor within the last 20 years, you have, I will guarantee the best roads of any town in the State that is still on the labor tax system. Further, I assume, that the competent road commissioner would not, as many pathmasters have done, order the sods, stones and muck scraped on to the roadbed, making it many times worse than it was before, in which condition they allow it to remain until rain washes the muck back into the ditches and then order the sods and stones thrown back upon the muck again. In the fall a stranger could not tell whether there had been any work done on the road that year or not.

If we would organize County Good Roads Leagues and adopt the money system of highway tax, would not the cities accept that as a sufficient guarantee that we were in earnest in the matter of road improvement? Would they not be satisfied that we mean to use every dollar that comes to our hands in the best possible manner?

We can learn something from our sister states engaged in road building. Massachusetts whose area is about one-sixth that of this State, has built within the last seven years 300 miles of macadam roads at a cost of $3,000,000 or $10,000 per mile. New Jersey in the same time built 440 miles at a cost of $2,200,000 or $5,000 per mile. Thus in these two states, with an area of less than one-third that of New York, there has been expended on roads by State aid $5,200,000, and they have for their outlay 740 miles of permanent roads. What has been done in this State for road improvement during that same period?

In 1893, Governor Flower in his message to the legislature said that from correspondence with the town clerks of the State he had been able to compile statistics showing that there was being expended annually in this State under our system of highway improvement the sum of $3,000,000; that same ratio for the last seven years amounts to the enormous sum of $21,000,000 which has been expended in this State for the improvement of our country roads, and what have we got to show for it? Practically nothing. It is difficult to understand what such a vast sum represents. Think of it, enough to buy Cortland county and have money enough left to buy grain seed with which to sow it this spring and pay your hired help until you could sell your farm product in the fall; almost as much as that hugh stone pile, the State capital, cost, which many thought was a needless expenditure, but for which we have the finest capital building in the United States. But for our $21,000,000 expended for highway purposes we have not even a pile of stone, unless it be in the middle of the road, where we have to drive over it. Little wonder that the farmers are beginning to cry out for some better system of highway improvement! Our wagon roads are the great high-

ways of commerce; over them are carried many more tons of farm produce than over all other freight carriers combined; over them all raw products first must move. The Department of Agriculture at Washington, basing estimates on the best data obtainable, fixes the cost of hauling over country roads, in round numbers at $1,000,000,000, or more than one-third the market value of the entire agricultural product of the country, and by careful comparison with the cost of hauling loads over the good roads of European countries, it is found that two-thirds of this enormous expense is chargeable to the bad condition of roads.

The fact that the national Government has established a department of road inquiry at Washington, is an evidence that national aid is not far distant. The Post Office Department at Washington, has for some time, been discussing the advisability of establishing postal savings banks, and the investment of deposits that would accumulate in such institutions has been a troublesome question in the department. Inasmuch as all safe investments are eagerly sought by rich corporations and the wealthy men of our country, they need all and more chances for safe investments than the present conditions of the financial world present. Therefore before the proposition for the establishment of postal savings banks can take form, some new scheme for investments must be founded and created. The proposition to loan such funds as would accumulate in such institutions to counties for road purposes at a very low rate of interest, say two per cent., is not a visionary one of my own, but is being discussed by eminent, careful and thinking men, and may eventually be formulated into some plan the advantages and benefits of which are clearly beyond our powers of imagination.

Advancement and improvement in all civilized and enlightened countries travel on the car of time. Mark the changes in local travel and transportation. But a few years ago the cities were content with putting down pavements, thereby giving better facilities for travel and transportation for the benefits of trade. Then very soon the horse street car was brought into use to facilitate travel in the busy centers, but soon that became too slow and

electricity was harnessed to the car that business facilities might keep pace with the progress of time; and now New York city is going to expend $35,000,000 in building an underground rapid transit railroad, and, strange as it may seem, doing that without calling upon the taxpayer for a single penny. The Canal Commission appointed by the Governor of the State recently, recommended the improvement of our canals, the cost of which is estimated at $60,000,000.

Where are our country roads during all this period of progress? Just where our grandfathers left them and practically in the same condition.

The "Higby-Armstrong Law," provides for the construction of permanent roads under State supervision, that is macadam roads that will wear a long time with but little expense for repairs. This law provides that the State shall pay 50 per cent., the county 35 per cent., and the town or the petitioners 15 per cent., of the cost of construction. There is now a bill before the Legislature, if it has not already passed, and if it has not, it, in all probability will pass, appropriating $1,000,000 for road purposes under this law; that means that there shall be a like amount raised by direct tax in the localities where the roads are built, thus creating a fund of $2,000,000 to be expended in road building.* There has been built under this law twelve and one-fifth miles of road at a cost of $6,717 per mile. Cortland county has in round numbers 1,000 miles of road, one-half of which are important roads. Therefore, if it were possible for us to have the whole of the appropriation expended in this county, we would get about half our important roads macadamized, or if continued, we could have them completed in about two years, and we will have paid a tax of about 15 per cent., of our assessed valuation. Then the question at once presents itself. Will the value of our prosperity be thereby advanced sufficiently to warrant such taxation? That may perhaps be a debatable question. I most earnestly urge each taxpayer to examine carefully and critically the "Fuller Law," if he has not already done so, and while some defects may be found, it seems to me that it certainly has many advantages over

* Only $150,000 was appropriated for this purpose last year (1900).

the labor system. If it were generally adopted, it would be an evidence to the cities, to the Legislature, to the Governor, and the State in general, that we are in earnest in our efforts for more and better highway improvement. This would give us more and better legislation in the future.

There are many other thoughts that present themselves, when this matter is taken up for discussion. Permit me to call your attention to the employment of convict labor in road building. Some counties have already been experimenting in that direction, with what results I am uninformed. Of course they are counties that have more convict labor than we have in this county, yet it costs us about $1,000 a year to board our convicts. A portion of them are kept in our county jail in idleness, another portion in the Onondaga penitentiary, and the penitentiary get the benefit of their labor while we pay their board. Most of these convicts are able to earn their board, and many of them much more than their board. Once the problem is worked out, how to utilize this waste labor, and make the convicts earn their own board instead of requiring the taxpayers to do it, it may result in some benefits to our highways.

Bovine Tuberculosis.

CONDITIONS MISTAKEN FOR THE DISEASE.

By Dr. William J. Murphy, New York City.

The subject of bovine tuberculosis has received a great deal of attention from physicians and veterinarians alike for many years, and of the many animal ills it is probably the one most frequently discussed, yet the least understood. Because of the prevalence of tuberculosis in meat-producing animals and the possibility of transmission from animal to man, the disease should be most carefully studied and investigated. Proper precautions should be exercised to prevent its spread, and various sanitary measures adopted which should aim to free the bovine tribe from the terrible scourge with which it has so long been afflicted.

No doubt the cow and her diseases are closely allied to many human ills, and facts tend to prove that the disease tuberculosis in man and animals is identical. In the human subject the disease is not at all times readily diagnosed, and frequently other conditions with apparently similar manifestations are mistaken for it. The same is true with the disease and its diagnosis in animals. At times its existence in the live animal is very questionable, and conclusions hastily drawn often lack verification upon a subsequent post-mortem examination. I have seen it generalized in the young steer, where its presence was never suspected and was seemingly in perfect health. I have seen it in the blooded bull, where the tubercular matter had permeated every tissue and organ of the body, yet by no manifestation was the disease revealed until the animal was butchered for food.

Thus it is evident that tuberculosis can exist without its presence being known. On the other hand, I have seen very many

small, emaciated, worn out cows, weak, decrepid, ill-fed, with a painful, hacking cough, hardly able to walk, pictures of bovine misery and distress, seeming typical cases of tuberculosis for all appearances, prove upon slaughtering to be entirely free from disease, the lungs sound, the lymphatic langular system normal, or possibly unlooked-for conditions met which would account for the animal's decrepid state. If these had been but occasional instances, I would have thought that perhaps a greater experience and a closer observation would disprove views superficially apparent; but such has not been the case.

Tuberculosis in the cow is not a malady readily manifest like pleuro-pneumonia. It lacks the prominent lesions of actinomycosis. It is void the acute symptomatology of splenic apoplexy or anthrax. The signs which denote the presence of an acute disorder are absent. It does not run a rapid course through various stages, but is a disease slow in character, with symptoms irregular and often ill-defined. Sometimes the presence of all the symptoms in prominent forms seems to make the diagnosis simple, yet a post-mortem examination reveals no trace of the disease. Tuberculosis is not responsible for the decrepid state of every cow. Other causes—not always diseases—are often responsible for the cow's decline. Naturally appears the question, what conditions and what diseases are mistaken for those of tuberculosis? There are a number of them. Some are of frequent occurrence, others are met occasionally. Some present lesions resembling those of the disease with which they are confounded, and some present very little similarity when carefully considered. Foreign bodies taken in with the food are responsible for a great deal of bovine distress—far more than one might imagine—and are a very prominent cause of lesions often mistaken for those of tuberculosis while the animal is alive. We have similar emaciation, a hacking cough, generally unthriftiness. Many of the obscure diseases of the cow, her frequent indispositions, her occasional cough, her loss of appetite and her different annoying and perplexing actions, arise from the presence of foreign bodies in the stomach and the distress which their

presence sometimes occasion. In the stomach of the cow can almost always be found nails, pieces of barb wire and various extraneous objects. I should say that at least seventy-five per cent. of the cows used upon the farm or in the dairy are so affected. Some experience no ill effects from their presence, while others are sickened and emaciated by the inflammatory action which the irritating substance causes as it becomes lodged in the coats of the stomach or works its way through that organ into other tissues.

One time I selected a thin, worn-out cow, presenting all the external manifestations of tuberculosis as a case illustrative of the ravages of this disease. Upon a post-mortem examination, the lungs were sound and perfect, but a large table fork protruding through the coats of the stomach and surrounded by a large field of inflammatory exudates, readily accounted for the animal's wasted appearance.

Catarrhal pneumonia in cattle often leaves lesions in the lungs which have been mistaken for and accepted as evidence of the existence of tuberculosis, although the two conditions are entirely different. Where the disease has been of a severe type, we may find a portion of the lung destroyed and in its place, an abscess of varying size, encapsulated and presenting a varied degree of consistency, according to its age. Beyond its mere presence, it exerts no ill effect upon the animal and remains at all times different from the deposits of the disease with which it is confounded. The deposits of actinomycosis in the lungs of cows can not be distinguished from the deposits of tuberculosis by the unaided eye.

Throughout the West, a large number of emaciated steers are bought and shipped to distilleries in Pennsylvania and other States to be fed, or, more properly speaking, stuffed with the refuse from these concerns. Within a month they undergo a wonderful transformation. They rapidly take on flesh and are then shipped to abattoirs throughout the country. While they may appear to good advantage, they in no way equal the corn or grain fed animal, as an article of food. In the short space of one

month, this distillery food has greatly impaired the animal's sight and many of them are totally blind. If they remained long enough, they would all be similarly affected. The lymphatic glands at the base of the tongue are enlarged from twice to four times their natural size and are generally the seat of an abscess, which, from its size alone, must materially interfere with the animal's deglutition. No doubt the glandular system throughout the system has been similarly affected. If these animals were kept long enough under such conditions and forced to partake of this food for a sufficient time, say, three or four months, I have no doubt that the lungs, the liver, the various internal organs, would become affected in the same way as the hide, the eyes, and the glands at the base of the tongue; while a condition due entirely to the nature of the food which the animal received, would, in all probability, be mistaken for lesions of tuberculosis.

Evident is it that bovine tuberculosis is a disease that is frequently confounded with ills and conditions, of perhaps apparently similar manifestations, but to suffer the condemnation of such animals as victims of plagues, with which they do not suffer, is an injustice to the farmer, a wrong to the stock-raiser, the propagation of a groundless fear to the mother, an imposition upon the public, an unfortunate blight upon our herds and an opportunity for foreign nations, who are jealous of our progress and our commercial activity, to discriminate unjustly against American cattle, American dairy interests, our cows, our meats, and the various food products prepared from our meats.

There is a disease tuberculosis. It frequently exists in cows. Sometimes it is local, and often it is generalized in form and is a malady that should be carefully watched to prevent its ravages extending beyond the limits of an animal plague and exerting its deteriorating influence upon the health of the human family. It is an unfortunate fact that nearly all the measures employed to eradicate tuberculosis, neither aim to exterminate it when it exists nor prevent its appearance when it does not exist. It is not surprising that with an ill so deceiving, with a malady so

frequently the topic of conversation, various devices should be employed to assist in the determination of its presence in a suspected animal. We live in an age where wonderful "discoveries" from the fertile brains of "scientific explorers" are thrust upon us in rapid succession only to be accepted for a time, heralded as marvelous truths, tried, doubted, cast aside and abandoned. In my short life I have passed through an era of vaccine, mallein, antitoxin, pleuro-pneumonia, tuberculin, and we see them all travel the one path from spontaneous adoration through a varied career to a well deserved obscurity. They are generally born a proprietary article or the result of a secret process of preparation. They bloom for a while and then fade away, and with them go their victims, their advocates and the condemnation of a fickle world.

A FEW WORDS ABOUT TUBERCULIN.

Its use has attracted considerable attention. At first it was offered as a valuable remedial agent for the cure of tuberculosis, but being unable to sustain that reputation, it has since posed as a means of ascertaining the existence of tuberculosis in an animal when nothing else suggests the possibility of its presence.

Perhaps I am not in a position to criticise the action of tuberculin, or to comment upon its efficacy as a diagnostic agent. I admit that I have had no practical experience with its use. I never injected it into an animal to verify a suspicion of tuberculosis, principally because I reside in a large city and as yet the opportunity has not presented itself for me so to do. Neither do I wish to prejudice anyone against its use. Sometime ago the use of mallein was strongly recommended as a useful aid in the diagnosis of glanders in horses. I tried it in a number of instances and the results were entirely disappointing. In several pronounced cases of glanders with apparent manifestations, the test gave no reaction, and so far as I am concerned, its employment is not only unavailing but useless and dangerous.

Let us return to the subject of tuberculin. From time to time there have been brought to an abattoir within my jurisdiction, a

number of cows which have been subjected to the tuberculin test and according to its provings, were affected with tuberculosis. In all the number that were slaughtered at different times, I have seen but few cases of generalized tuberculosis among them, and I am inclined to think that possibly they were obtained more by accident than by operation of the test. From what I could learn, the ones most affected gave the slightest reactions under the test. Many of the cows in which what might have been tuberculosis, but probably was not, was discovered only after the most diligent search. They were in the form of isolated, minute pin-head deposits in various glands and in the structure of the liver and were accepted as responsible for the provings of the test. One thing is certain: If what is often accepted as evidence of tuberculosis by the tuberculin operator is really tuberculosis, then the entire bovine tribe, both young and old, are hopelessly afflicted with this disease—hardly a reasonable supposition. Among them were cows in which the most diligent and careful scrutiny failed to discover the least sign of disease, and I learned that in one of these animals, the rise in temperature had been most pronounced.

While my observation in regard to the efficacy of tuberculin has been entirely negative. I do not doubt that it has many advocates and many of them have advised me that I have been unfortunate in witnessing the work of careless or incompetent operators—hardly an acceptable explanation. To me the object of tuberculin has been a most interesting study, and a study of those who advise its use, has often been a more interesting study. One of the most remarkable truths connected with the subject seems to be the fact that a negative reaction with the test is not demonstrative of a freedom from tuberculosis. An animal may be a victim of generalized tuberculosis and yet the test not reveal its presence, a tuberculin idiosyncrasy. Time alone will decide the fate of tuberculin. It has banished into obscurity many popular delusions which have from time to time become associated with the medical creed, and I fear that when posterity reads the history of medicine, it will find that in a cer-

tain age, there flourished an idea quaint, queer, but unstable, that certain diseases of animals could be diagnosed by certain animal poisons being injected into their delicate composition, but with the advance of the light of truth, this idea, fantastic and amusing, fell by the wayside and was lost sight of in the onward march of the science of medicine.

No one wishes to partake of meat from animals diseased or sick. The health of the nation is at stake, and in no way can the disease-breeding material gain an easier entrance into the system, than with the food. But every cow is not afflicted with tuberculosis. While it is a frequent bovine ill, it is not a necessary complement to their composition. Of all the domestic animals, the cow is probably the least understood. Veterinarians do not devote to her the attention that her importance demands. The animal most vitally interested with human existence is left to the care of those who understand almost nothing of her ways or wants. She is kept in filth, is fed with filth, and her very surroundings breed the disease we try in vain to cure.

How will we eradicate tuberculosis? It is a subject that interests not only the veterinarian, but the physician, the farmer—the universe. We will answer the question by saying how the disease will not be exterminated. It will not disappear as long as the dirty, filthy cow shed remains. It can be bred into animals by the manner of their surroundings. The cow requires good air, light and ventilation, in place of the dark, stuffy pest holes, where she is usually confined. She must have competent attendants, instead of the brutal, worthless, repulsive degenerates, usually entrusted with her care. She must receive good, wholesome food, in place of refuse. She must be cleaned, exercised and manipulated with the care and delicacy that her complex mechanism demands and should receive. When the cow is properly kept, tuberculosis will disappear. When we thoroughly understand her ways and necessities, instead of injecting into her system products of disease—a notion whimsical, irrational and dangerous—we will have learned that this disease is an ill for which man's ignorance and mismanagement is largely responsible. By

the proper observation of ordinary sanitary measures, this disease can be largely overcome, if not entirely eradicated. A subject fraught with such dangerous possibilities, requires the employment of measures not only heroic, but persistent and effective, if we wish to avoid a possible eradication of the bovine tribe and destroy a potent factor which might operate disastrously in the ultimate degeneration of the human race.

Bovine Tuberculosis in Its Relation to Man.*

By Edward Moore, M. R. C. V. S., Albany, N. Y.

This subject is a story old—older than many of the hills and valleys that beautify the landscape to-day, older than some of the islands of the sea. I speak of its antiquity because in this country bovine tuberculosis was rarely recognized until 1890. The disease in cattle has been described in veterinary works, printed mainly abroad, under such headings as tubercle, consumption, wasting, pining, and scrofula; also called angle berry and grape disease by butchers, because of the knotty growths found by them in affected carcasses, and it has been known to veterinarians abroad for a great many years; yet our stock papers, agricultural journals, veterinarians, and the American public generally gave the subject no importance prior to the year above mentioned. I searched the volumes of the *Country Gentleman* for ten years prior to 1890, and, outside of articles by the author of this paper, the subject was not mentioned until December 19, 1889, when it was stated that "cattle tuberculosis seems to be spreading on the continent of Europe, according to the statistics produced before the Veterinary Congress lately held in Paris. Of cattle slaughtered in public abattoirs, more than one per cent. were found affected with the disease." One might search back to the landing of the Pilgrims in vain for information on this subject prior to 1888. At a meeting of the New York Farmers at the Metropolitan Club, February 18, 1896, Mr. Theodore A. Havemeyer said: "I have been for a long time a breeder of cattle, as was my father before me. Up to 1888 I think tuberculosis

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was not known by my father; up to that time it certainly was not known by me." The organization he was speaking to is composed of about eighty of the wealthiest and most representative men in this country, who own high-class stock farms. Every member had large sums in pure-bred cattle, and was vitally interested in all such subjects, and, although many of them had had tuberculosis in their herds for years, they did not know it. The medical profession up to this time was in no way exercised over the danger of the communicability of tuberculosis from the bovine to the human race, nor, indeed, did they lay much stress on the infectiveness of the disease from person to person. Then suddenly all America was stirred by articles from veterinarians, physicians and laymen. Later, laws were enacted, cattle commissions appointed, inspectors were sent out, herds were subjected to the tuberculin test, and animals that gave satisfactory reactions were killed. Many physicians went to see post-mortems, were convinced of immeasurable dangers, and fell into line. Stock owners trembled and the public was in a panic, and saw more danger in milk than in rum. The tidal wave swept over the country; State and local boards of health, medical and veterinary medical societies, agricultural societies, farmers, grangers, dairymen, milkmen's associations, and the nail-keg and soap-box aristocracy of the country store were all discussing the "new" disease in cattle and its relations to man. The disease, however, was not "new," in fact, is one of the oldest, but it was new to most of the people and it served as a great scare. It was treated as if it were a most desperate scourge just imported into the country, when, as a matter of fact, it was no more prevalent in proportion to the number of cattle than it had been.

Legislative Appropriations for Stamping Out.—The chief aim of health boards heretofore has been to destroy tuberculous cattle; the greater the number condemned and slaughtered, the greater the glory. No matter that it struck consternation into the ranks of the proprietors of a great industry. No matter that in many cases the richest blood of heredity in pure-bred herds was forever lost—lost though it had cost lifetimes and fortunes to obtain;

lost through the wanton, needless, insatiable thirst for a big killing bee. What did it matter that a great paying institution employing many hands was wiped out; that the proprietors were financially ruined; that employees were thrown out of work; that great farms were deserted? Slaughter was the war cry. Salvation they dreamed not of. If it were proved that our people contracted the disease from the cattle, I would heartily favor such slaughter. Or from the cattle owner's standpoint I would favor it if assured that the undertaking were practical, and that its cost would be too exorbitant, and that the infection could then be kept out of the State. The framers of the laws under which the inspections have been made and the members of the State boards of health seem to have given no thought to the immensity of the task, or the expenditure such a plan entails. If they have, we have not been told how they propose to succeed. The year-book of the Department of Agriculture for 1897, states that the government has made and distributed to State authorities sufficient tuberculin to test 57,000 cattle. The census of 1890 gave New York State alone 2,131,392 cattle. How much tuberculin would be needed then to examine the cattle in all the states? The United States government reports for 1897 placed the number of milch cows at 18,113,000; other cattle, 32,647,000. Total valuation, $877,169,414. If we could wave over this State a fairy wand and thus instantly banish all bovine tuberculosis, how long would the immunity last, while the remainder of this vast country is full of infection, and the bacilli can retain their vitality for months in a bale of hay, and the winds can blow them over the borders? I know of a stock farm where $100,000 was spent for farms and buildings, and $30,000 for bure-bred cattle, and in about a year these cattle were disposed of at any price, on account of the methods pursued by the State in which the farm is located. Tuberculosis in man, and such of the lower animals as are susceptible to it, is generally recognized as a specific infectious disease due to the tubercle bacillus, and this bacillus in either species is considered as practically the same. We are interested in this paper with tuberculosis in the human and

bovine species, the two great families in both of which it exists to an alarming extent. The disease occurs in a limited way in several of the domestic animals other than the ox, but assumes very little practical importance so far as they are concerned. The disease is a slow and insidious one, wholly different in this respect from such diseases as cholera and small-pox of the human, or cattle plague of the bovine. Tuberculosis in cattle does not necessarily kill; on the contrary, many animals maintain ordinary health and high condition, apparently suffer no inconvenience from it, and finally die of some other cause. In other instances there are signs of constitutional disorder with more or less of the symptoms common to it, and in acute cases followed by death within a few weeks or months.

Breed.—All breeds are susceptible. It has been erroneously believed that Jersey cattle were most prone to tuberculosis, but the royally bred and the common scrub are alike subject to it, just as the various races of men are.

Sanitation and Spontaneity.—The old writers gave as some of the causes of tuberculosis, bad ventilation, filth and insanitary conditions generally. No combination of ill conditions can produce a single case of the disease, nor can the most perfect and elegant buildings and hygienic surroundings offer immunity from it. Of course this is easily accounted for now that the means of infections are understood.

Heredity.—Dobson, quite an authority a few years ago, in his work on the ox, says: "There seems to be no doubt as to the hereditary character of this affection, so that in no case should a bull be chosen from stock which are thus diseased. . . . A report to the parliament of Victoria, New South Wales, in 1886, says that heredity certainly plays a most important part in the propagation of the disease." This is the opinion of about all veterinary writers. Since the discovery of the tubercle bacillus and the application of the tuberculin test, it has been found that calves from tuberculous dams, if removed immediately after birth

from all chances of infection, rarely show disease. Heredity has but small claim to attention now.

Predisposition.—We have been assured by all writers that predisposition and conformation were most important factors. We know to-day that no matter how narrow-chested and weak constitutionally an animal may be, tuberculosis cannot occur without infection, and it does not seem to select the puny ones especially.

Contagion.—We have seen that most of the old ideas about tuberculosis have been dissipated, but its infectiveness is beyond cavil. That it will spread among healthy cattle when they are kept with diseased ones is well known.

Tuberculin Test.—This has been stated by many to be an infallible guide in the diagnosis of bovine tuberculosis. I may say that it depends largely on the infallibility of the man who uses it. If a correct selection of animals is made, leaving out any that should not be tested, and the proper amounts of tuberculin are used for the varying ages and conditions, then if the temperatures are taken without errors we shall have tables that if correctly interpreted, are very valuable in determining the number of animals that are free from tuberculosis and the number that are not. But tuberculin is not an automatic machine; it requires brains, judgment and experience to make a test and then read the answers correctly. When used with these prerequisities, it is a highly efficient diagnostic agent.

Percentage of Diseased Cattle in Herds.—In some herds of cows of dairy age the percentage may run from twenty to ninety per cent., and now and then a herd may be found in which every animal is infected. In herds in which there is a goodly number of young animals the percentage is smaller. Young animals are comparatively free from it. Mature cows give the largest percentage of victims, those from a year and a half to three years old the next, and those less than a year old the least. There seems to be diversity of opinion among physicians as to whether tuberculosis is more common in adults or children. This point

should be settled, and it should be demonstrated how and from what source infants obtain infection. It has been convenient up to this time to attribute thousands of cases to the ingestion of cow's milk. The *Veterinary Journal*, London, England, for June, 1889, gives an account of a meeting of the British Medical Association at Glasgow, and Dr. Carpenter stated that eighty per cent. of the cattle sent to the principal meat market in London were affected. Professor McCall said that twenty-five per cent. would be nearer the mark for Glasgow. In Saxony it is said to be about one per cent.; in Berlin, 3.2 per cent. New York State Tuberculosis Committee's Report for 1895 states that about seven per cent. is figured as the average for the whole State. The writer examined a herd in this State in which 27 out of 30 animals were tuberculous, and some were in the last stages of disease. Three youngsters were free from it. Another herd examined in Connecticut gave about 50 per cent. of diseased adults. Nearly half of the healthy ones were under two years old.

Transmission.—We have now arrived at the point upon which hinge very largely the health and welfare of humanity and the fate of millions of dollars' worth of cattle. Is bovine tuberculosis communicable to the human subject? This is the paramount question, and it must be intelligently answered. The physician, the biologist, and the veterinarian are called upon to solve this problem, and below are given opinions from each, as well as from the State Board of Health, using these merely as examples of the universal opinion on the subject. We have noticed that so far as heredity, breed, sanitation, spontaneity, and predisposition are concerned, there has been a vast amount of error taught. We will now consider transmissibility. J. H. Girdner, A. B., M. D., in an article published on the disease germs and how to avoid some of them, states that "the other principal source of human infection is from drinking the milk and eating the flesh of tuberculous cattle. Tuberculosis in children usually manifests itself in diseases of the bones and joints, white swelling, and in enlargement and suppuration of the glands of the neck.

In nearly all such cases the infection comes from drinking milk from tuberculous cows." Bulletin 118, New Jersey Experiment Station, on the suppression and prevention of tuberculosis of cattle and its relation to human consumption, by Julius Nelson, biologist, contains these words: "But it is principally for man's sake that the lower animals should be included in the general scheme for freeing the country from this evil." In the *Journal of Comparative Veterinary Medicine*, December, 1897, C. C. McLean, veterinary surgeon, and a milk inspector in Pennsylvania, contributes an article which was read before the State Veterinary Medical Society. The following is a part: "The houses of the wealthiest in the world and the homes of the poorest testify that our meat and milk supply cause thousands of deaths from this disease every day. Tuberculosis is therefore the most important disease for the veterinary profession to deal with." The report of the New York State Board of Health to the Legislature of 1895 contains the following: "There is a complete unanimity of opinion now in the scientific world as to the communicability from man to man, and from animal to man, and man to animals. That milk and its products will convey it has been proved repeatedly. This has now past beyond the experimental stage, and is no longer open to doubt. It has also been proved that lower animals fed with tuberculous meat become tuberculous as a result of such feeding." Such, then, is the common opinion to-day. Many of the statements are couched in language calculated to defy further investigation and to discourage even a doubt as to their correctness; however, we shall endeavor to show by the conditions as they exist between man and animals, and animals and man, that no stress of words, no amount of bigotry, no arbitrary proclamation unsupported, can hold the truth in bondage. If the State Board of Health believed its own teachings and was sincere, why did it inspect, tuberculin test, condemn, quarantine, and tag for slaughter various lots of cattle which, according to the board's reports, were inimical to the public health and were prone to spread disease among other cattle, and after holding them in quarantine a considerable time to pass a resolution and

send out the following notice to the owners of said diseased cattle?

"You are herewith notified that the quarantine imposed upon your cattle by the inspectors of this Board, in pursuance of orders from this Board, and in conformity with the power granted by article 4 of chapter 661, Laws of 1893, is relieved and raised, and the tags and other devices used to mark said animals may be removed by you."

As well might our penitentiaries be thrown open and the murderers and convicts be told to go free, and that any striped clothing or other devices used to mark said criminals might be removed by them. The Syracuse (N. Y.) Board of Health has determined that hereafter all the herds whence the milk supply of the city is derived shall be kept under municipal supervision, and that all dairy animals shall be examined by a physician at least twice a year. A round aluminum tag is fastened to the ears of the healthy animals, and an oblong tag to those of the diseased ones. If physicians in State boards of health and in other positions are competent to handle animal diseases, then, to be consistent, we should have a corps of veterinary surgeons to guard the public health. Both are doctors. Could Miles do what Dewey did? Could Dewey win where Miles has won? Both are fighters. While I have the utmost respect for and confidence in the ability of the medical profession, I can but regret that its code of ethics allows its members to imperil its dignity by seeking positions and assuming rôles in which they are manifestly out of their proper sphere. To the honor of the profession be it said that its ablest members are not dissemblers, and that only its pygmies pose as veterinarians. But we have digressed from the subject of transmission. We have been told over and over again that "the slight difference between the bacillus of man and that of cattle is a temporary peculiarity, and is overcome when the conditions are favorable. . . . That all over the world tuberculosis in man and cattle coexists in the same locality; that among fish eaters and in countries having no cattle tuberculosis is practically unknown. That it prevails largely among beef eaters and cow-milk drinkers; that among

our Indians, who eat diseased beef raw, 50 per cent. die of tuberculosis, while among the northern Indians, who never see beef, it is relatively unknown, goes to show that the conditions being favorable the infection passes readily from ox to man."

Professor Law used this argument in an article published last month: "I deny that it is shown that the infection passes readily. Coincidence is the only thing established. Conditions that favor the spread of this disease from human to human also contribute to its dissemination from bovine to bovine." Rivers and railways often run side by side for the reason that nature in such places favors both, and not because there is any relation between them, or that one is necessary to the other. Since we know the cause of tubercle, will any one have the temerity to assert that cattle must be in close proximity in order that infection may pass from man to man? Or, if there is a healthy herd of cattle on an island not inhabited by mankind, and we wish to spread tuberculosis among them, will it be argued that it is necessary to send a number of consumptive people there, as well as a few tuberculous cattle? If so, the answer is simple. The tubercle bacillus is not a parasite requiring an intermediary bearer. In the fish-eating frozen regions, where cattle are not kept, the bacillus meets obstacles fatal to it. If eating diseased meat raw is such a potent factor, why is it a fact that the carnivora rarely develop the disease? Again, beef is not so highly infecting. In many tuberculous animals the muscles or meat is not diseased. It is not necessary to speak of cooking as a safeguard at this time. This paper deals only with bacilli that are capable of infection, and not with those that have been destroyed, or are therefore harmless. Why hunt for a wild tribe who eat beef raw, when we have the better evidence of millions of our kind who drink milk and eat its products raw, and we do not find 50 per cent. of them dying annually from tuberculosis and all other diseases put together? And it has never been shown that human tuberculosis was the result of infection obtained from cattle, either by germs taken into the system by inhalation, or by the ingestion of the products of

diseased animals. The cases reported and quoted by writers are not supported by evidence of such transmission, and as we proceed it becomes more apparent that evidence had to be manufactured, the natural output being wholly inadequate to the needs of the advocates of that theory. About 20 years ago I wrote articles on bovine tuberculosis for newspapers and live-stock journals, and called attention to the possibility of its transmission to the human. That the disease rapidly spread among cattle by infection was pointed out. The advice given then is equally applicable now—viz., that cattle owners should have their herds inspected; that the diseased ones should be isolated; those that are physically bad should be killed. Disinfection was advised for stables, etc. In 1885, after killing two thousand dollars' worth of cattle in another state with the owner's consent, there being no law to compel slaughter in any state at that time, I gave the *Albany Argus* a column article on Animal Diseases and their Relation to the Public Health, and on the subject of tuberculosis, said: "How much of the prevalence of human tuberculosis may be due to milk and beef from tuberculous cattle is a question yet to be determined, and is a serious one indeed." Therefore, the position I now take after having warned the public many years ago, and frequently since, to use all possible care to prevent the transmission of tuberculosis from cattle to man, is arrived at from a vast experience with the disease in cattle in England, Canada, and the Eastern and Middle States, and from a study of the people most exposed to any infection that might be possible from such animals.

Bacilli in Human and Bovine.—Charles Darwin says that man has given rise to many races, some of which are so different that they have often been ranked by naturalists as distinct species. The races differ in constitution, in acclimatization, and in liability to certain diseases. On these same principles micro-organisms are very much modified by the conditions surrounding them. Sternberg, in his *Manual of Bacteriology,* states that the tubercle bacillus is a strict parasite, and its biological characters are such that it could scarcely find natural conditions outside of the bodies

of living animals favorable for its multiplication. It therefore does not grow as a saprophyte under ordinary circumstances. But it has been noted by Nocard and Roux that when it has been cultivated for a time in artificial media containing glycerin it may grow in a plain bouillon of veal or chicken, in which media it fails to develop when introduced directly from a culture originating from the body of an infected animal. The human is omnivorous, the bovine is herbivorous. The normal human pulse is about 72, that of the ox 40 to 45. The normal temperature of the human is 98.6° F., that of cattle from 100° to 100.5° F. Thus the normal temperature of the ox is equal to quite a fever in the human. I am of the opinion that there is something in the human body antagonistic to the favorable development of the tubercle bacillus of the bovine, and there is in the body of the bovine a check to the colonization of these animals by the bacilli from the human species. Hordes of Hottentots transferred to the polar regions would rapidly perish, yet the Eskimo thrives there. Sternberg says: "A certain species of bacilli may be pathogenic for one species and not for another. Thus the anthrax bacillus, which is fatal to cattle, sheep, rabbits, guinea-pigs, and mice, does not kill white rats. The bacillus of mouse septicaemia kills house mice, but field mice are fully immune from its pathogenic effects. On the other hand, the bacillus of glanders is fatal to field mice, but not to house mice." Here is a distinction as finely drawn as that which I have alleged as existing between man and the ox. I believe that the tubercle parasite of man has by its long existence in that host acquired, as it were, individual characteristics which unfit it for life in the ox, and that the "micro-organism" of tubercle, which for centuries has had its habitation in cattle, has become practically specific to that class of animals. I am therefore persuaded that if the environment be changed in either direction the pathogenic power will be lost. I have read of cases of accidental inoculation of the human from the bovine, and if they have occurred they must be very rare, inasmuch as none have come under the writer's observation, and probably no one has had greater experience with tuberculosis in cattle. I am positive

that many supposed cases have been incorrectly interpreted. Suppose one member of a family on a farm develops tuberculosis, and there are one or twenty tuberculous cows on said farm, it does not prove that the individual obtained the infection from the bovine. It is quite probable that he has been exposed to infection from human tuberculosis hundreds of times. Many reported cases hang on just such vague evidence as this. If a man walks into a bank, and while there is found to have twenty dollars in his pockets, is it *prima facie* evidence that he has become infected with the germs of wealth of that institution? Or, is it not possible that he was suffering from monetary engorgement when he entered that hotbed of filthy lucre? It must be proved beyond peradventure that he was penniless when he entered the building if we are to blame the bank for the condition of his pockets. Just as positively must we know that infection passes to the human adult or child from cow's milk or its products, or from beef, or through ingestion in other ways, or by inhalation of bacilli from the bovine, and that they alone establish the disease, ere we can truthfully say there is such transmission. How may we know that a human being is tuberculous when no germs can be obtained from the subject, and no marked symptoms are observed? If an adult or child has tuberculosis, and it is proved that such patient has partaken of milk for any length of time from a cow known to be tuberculous, it is by no means certain that infection came from the cow unless there is proof that it did not come from the human, and that it did not exist prior to his ingestion of the milk. Let us take cognizance of the difficulty of establishing such a fact. Humanity wanders incessantly. The germs of human tuberculosis are wafted on the winds, are carried by the waters, may be brought home in food or clothing, may be inhaled at church, theatre, or hotel, in motor or parlor cars. They do not stand out in large black masses, like the rocks the mariner is ever alert to avoid, but without our ken, noiseless, imperceptible, and intangible they surround and invade us. They do not sting when they capture a victim; then how can we know the time, the place, and the source of infection? Even the milk from

that tuberculous cow just mentioned may be further contaminated by bacilli from a human being before it reaches the consumer, and the bacilli from the human may establish disease, while the bacilli from the cow prove inert. Consumption in people is so common that physicians have unlimited facilities to study its aetiology. For instance, in New York State the deaths from this disease for eight years from 1888 to 1895 were 104,804, an average of 13,100 a year, and it averaged about eleven per cent. of all deaths. The annual report of our State Board of Health for 1896 says: "Tuberculosis in some form or other accounts for a very large percentage of the deaths in the State, and when it is known that there is at the present time a large amount of meat consumed from tuberculous cattle, and that milk from such cattle enters into the dietary of the people, and that there is danger when the bacillus is ingested, it is believed to be a most potent source of infection, especially in children." Note the expression, believed to be, and if we read from scores of writers on this subject, we shall find that when they come to this point they all hide behind just such terms. Where are their facts, and why do they not give us some positive statements, with convincing illustrations of the methods by which they proved to themselves that such was the case? Too long have writers worn the thinking caps of others, too confidently have they accepted the statements of supposed authorities. There has been too much heredity in ideas and quotations. Practically all the people of the State eat the products of cattle all their lives, and tuberculosis in cattle is well distributed throughout the State. Now, then, if the disease passes readily to man, even laymen should be able to note the fact where large numbers of cattle are infected. But they, and their physicians, and their veterinarians have merely presumed, imagined, believed, supposed, and concluded that such "might be the case." One thing is well known, viz., that 13,000 human consumptives give off enough infective material annually to account for all the human tuberculosis in the State without the aid of a single bovine.

Transmission from Human to Bovine.—It is of less interest to physicians whether tuberculosis is transmitted from the human to the bovine; still, if the disease is intercommunicable, as we are assured it is, then it is equally important either way. I have not been able to learn of a case where the disease was established in a cow or a herd from human sputum. Dr. Cooper Curtice says: "In 1897 I tested two hundred and forty cattle in the vicinity of Saranac Lake, New York. Every one there supposed that I would find tuberculosis in herds that fed in the fields where the consumptive patients that resort to this place take their exercise. Not one case was found." Not only this, but the herd of the sanitarium had been previously tested with like results. If tuberculosis could be transferred to cattle from human beings, it should certainly occur at such a place as Saranac Lake, a sanitarium where thousands of consumptives resort. Thus, while feeding experiments may have been interpreted as showing in some instances that infection from human to bovine were possible, it seems very well established that the infection from man to cattle does not obtain when consumptive people and healthy animals occupy positions toward each other daily, which are calculated to offer every opportunity for such transmission.

Dr. Theobald Smith is certainly working in the right direction; his article, A Comparative Study of Bovine Tubercle Bacilli and of Human Bacilli from Sputum, is based upon scientific investigation of a very high order, and his deductions go a long way toward the establishment of the principles promulgated in this paper. He says:

"The absolute identity of tubercle bacilli infecting mammalia has been so generally assumed, and the assumption used as a basis for the enactment of sanitary measures having for their object the prevention of any transmission of tubercle bacilli from animal to man, that anyone who would attempt to question this identity must be prepared to meet considerable skepticism. Taking a broad biological position, we have every reason to examine into the assumed identity of the bovine and the human bacillus."

Exactly, and we shall facilitate this important work in proportion as we cease to be parrots in repeating what we have been

told, and as we rise above mere assumption and scan closely every bit of evidence, giving credence to nothing that is not warranted by scientific investigation, indefatigably pursued to the end, that truth may be established. Dr. Smith has demonstrated that human bacilli grow more vigorously from the start than do those from the bovine; that the length of the human bacillus is about two to three times that of the bovine, in cultures; also other morphological and biological characters in which they differ. More convincing are the divergencies in their physiological effects, as shown by his experiments, in which there was more rapid death of all guinea pigs inoculated with bovine bacilli than those inoculated from human sputum. Experiments on rabbits confirmed those of the guinea pigs. His experiments on cattle by the inoculation of bovine tubercle bacilli and human bacilli in some ten cases shows "slight local lesions at the point where the syringe was inserted when human sputum bacilli were used, the disease not spreading. When the bovine bacilli were introduced there was disseminated tuberculosis of the lungs, tubercular deposits in lungs, ribs, pericardium and diaphragm, extensive tuberculosis of nearly all the lymph glands of the thorax, and slight tuberculosis of the spleen, liver and kidneys." These differences are so great that comment is unnecessary. Dr. Smith summarizes them in the following language: "The foregoing experiments, while they show unmistakably the close relationship existing among the various cultures studied, nevertheless justify us, if only to guide and stimulate further study in establishing a distinctively human, or sputum, and a bovine variety of the tubercle bacillus." These modern experiments are infinitely more reliable than those so often quoted of earlier investigators, because our knowledge is greater, our facilities are better. I will presently offer some practical evidence from the everyday lives of people who are constantly exposed to the infection from bovine tuberculosis. I know the cattle, know the percentage of diseased animals in the herds, and have been aware of the existence of disease in the herds for from several to eighteen years. I have visited the people, dined with them when there were plenty of

bovine bacilli on the table to satisfy any ordinary craving, and I have noted the health of those families, especially that of the children, many of them having all their lives used the products of herds largely infected, and I have not yet discovered a single case of human consumption therefrom. It is axiomatic that if transmission is common, or even possible, the farms where large numbers of infected cattle are kept are the places where the fact can be best observed; because nowhere else in the world is there so much infective material, nowhere else are the bacilli so potent, nowhere else are people so exposed to the danger, if any exists, and at these places feeding and inhalation experiments so to speak, are constantly going on; and you will bear in mind that it is the mature cow that is oftenest affected, and it is from her that the largest amount of milk, butter, etc., are used. A vast amount of work has been done by scientists to demonstrate whether milk from tuberculous cows whose udders were not diseased contained bacilli, and it may be conceded that it does in some cases; they are also present in milk frequently when such milk is obtained from tuberculous udders. Sternberg, in his *Manual of Bacteriology*, says: "A more common mode of infection, especially in children, is probably by way of the intestinal glands from the ingestion of milk from tuberculous cows. That infection may occur by way of the intestine has been proved by experiments upon rabbits, which developed tuberculosis when fed upon tuberculous sputum." This is the sill in the doorway of investigation over which many a bright man has fallen. It is assumed that the infant will do exactly that which rabbits and guniea-pigs have done. All the evidence I have thus far collected indicates that it does nothing of the kind. Physicians as a rule are not familiar with the conditions surrounding a tuberculous herd, hence I have deemed it necessary to show you one in imagination that you may the better understand the facts.

Tuberculous Herd at Home.—Picture in your mind 200 cattle in elegant buildings of the immense size necessary to house such a family—electric light, proper ventilation, pure water, mountain air, drainage and plumbing up to date, strictest cleanliness, the

best food stuffs given in balanced rations, pure-bred animals, everything first class and all under the keen observation of experts who note details and record them—yet somewhere in the past a number of tuberculous animals were bought and added to the herd. Those diseased animals looked all right, else they would not have been purchased at high prices. And after a few years we find that 25 to 50 per cent. of the herd is tuberculous. Remember that cattle stand in rows in many cases. The manger is a continuous trough. The partitions between animals are low and the cattle can reach each other on either side. They can cough up and blow sputum to a considerable distance, where it may fall on cattle to be licked off, or on food, or in water, or in feed troughs. The animals are turned out for exercise or pasture, drink at one trough lick themselves and each other, and drool upon litter or herbage that others eat. When confined in the stable during winter, think how the dried sputum is converted into dust and wafted about by the breath blown from the animals, by their getting up, lying down, shifting feet, switching tails, the opening and shutting of doors, the sweeping, the general stirring up at the time of foddering, and you will realize that there is a series of motions night and day always operating to favor dissemination of the disease by ingestion, inhalation, and direct contact with mucuous membranes. Suppose that we say of 200 animals 80 are tuberculous; in this number are some with disease so located as not to be harmful to others, but many are diseased in organs which allow free exit to the infectious material. The attendants breathe this germ-laden atmosphere, they handle the cattle, and no doubt often convey to their nostrils and mouths sputum from the cattle. They and their families, and the proprietors and their families drink the milk, eat the cream, butter and cheese, if the last is made, and in some cases, though not often, they eat the flesh of calves or older animals. Here, then, is the greatest abundance of infective material—inhalation of germs before breakfast; at breakfast they are spread over the oatmeal, poured into the coffee, on the fruit, spread on the bread, taken in the glass of milk. All day the air is rich

with germs and they are served at every meal without extra charge, all furnished by the sanitary dairy company, unlimited, from the palace bovine home. Children often go into these barns, and are likewise exposed. What chances are there in cities for people to obtain infection from cattle, as compared to those just pictured in the country? Even the milk is most infective when freshly drawn from the cow, so far as bovine tuberculosis is concerned; the only way it can be more dangerous to people when served in cities and towns is through its contamination by bacilli from human consumptives. Yet your health laws all aim to protect the citizen; no one has ever suggested a law to protect farmers from infection by bovine tuberculosis. Again, the percentage of deaths from consumption is much higher in cities than in the country or in country towns. I recently wrote to some owners of herds where bovine tuberculosis has been long established and in which the percentage of diseased animals was high, and I quote the replies, omitting the addresses in some, but offer in evidence the original letters, which I trust you will inspect. In none of these places was milk sterilized, or any precaution taken to avoid infection. The butter that won the gold medal at the last Paris exposition was the product of a herd largely tuberculous. Thus we are again reminded that "All is not gold that glitters." A part of the scintillation may have been due to bacilli in this case.

The following extract is from a lady who has suffered extensive loss. Prior to the visit of the inspectors of the State Board of Health the farm and its herd of cattle were unequaled throughout the State.

April 4, 1899.

DR. EDWARD MOORE, *Albany, N. Y.:*

Dear Sir.—Your favor of March 6th received, and beg you will excuse my neglect in not replying sooner, but pressure of other matters crowded it out. In my opinion the actions of the State Board of Health were not only absolutely unnecessary, but absolutely criminal, and had I been in a position where I could, I fear I should have talked in Albany until some one was tired. My herd numbered nearly 200 head, young stock and all, and they

butchered over 100 cows, leaving me with a herd of young stock on my hands. Some cows, after slaughter, could not be found to have even a pinhead size of a germ, even upon microscopic examination, while with the majority, *if* they could find a germ as large as a pea that might be called a tuberculous germ, the men in charge were happy. At the time the State seized the cattle the creamery was full of butter, which was quarantined and a sample of each package sent to Albany and tested. After all the stock was killed we received a clean bill of health upon the butter. There was absolutely no foreign germs or anything detrimental in it. But what of that? For the sake of giving a few cranks a job for a while, $30,000 worth of stock was killed. The blow killed my farm, and I have never been able to pull together since. I have never known a case of human tuberculosis to arise from the use of milk from my herd, either directly or indirectly. Our cattle had better care than thousands of children, and a regular veterinarian three times a week, and a consulting veterinarian twice a month always, and as often as needed at other times. I will send you under separate cover a souvenir of the farm as it was. Trusting you may be able to allay such useless slaughter,

I am very truly yours.

The above 100 diseased cattle appear to have utterly failed to transmit tuberculosis to the people surrounding them or using their products.

HOTEL BRISTOL, NAPLES, ITALY, *March* 24, 1899.

Dr. EDWARD MOORE, *Albany, N. Y.:*

Dear Sir.—In reply to your favor of the 4th inst., I am always pleased to be of any service to you or any of my old friends.

In my 25 years' experience with cattle I have never known anyone who has had the care of cattle to have been infected with tuberculosis or consumption.

You are at liberty to use my name if you wish.

Very truly yours,

JOHN MAYER.

The above letter is from a son-in-law of Mr. Havemeyer, and these two gentlemen had one of the largest and best pure-bred herds of cattle in the world, and their herd suffered extensively from tuberculosis for years. Mr. Mayer has traveled across the ocean several times for the purpose of examining the best cattle abroad and purchasing the best animals he could obtain. He made special investigation as to the freedom of various breeds from tuberculosis, and imported a lot of Swiss and Simmenthal cattle because he believed they would resist the disease better than the animals then composing their herd.

MASSACHUSETTS AGRICULTURAL COLLEGE,

VETERINARY DEPARTMENT, AMHERST, MASS., *March* 7, 1899.

DR. EDWARD MOORE, *Albany, N. Y.:*

Dear Sir.—Your inquiry to the director of the station regarding tuberculosis has been sent to me to answer.

In so far as I know, no one has ever contracted tuberculosis from contact with the animals in our old herd, or from the use of the milk or meat from the same. The records of our students and graduates only show a very small mortality from consumption. These records are not to be relied upon to prove that any student ever contracted the disease from the use of milk from the college herd, for they have not always had it for use. Some years the boarding club, which is run by the students and not by the college management, gets its milk from the farmers in town. I send you under separate cover a bulletin giving the history of our old herd.

Very truly yours,

JAMES B. PAIGE, D. V. S.

The following letter is from a very prominent firm in another State who have maintained one of the largest herds in this country for many years. I have known that there was a good deal of tuberculosis in the cattle for 16 years, and frequently in that time I have been at their farm and partaken of three meals

a day for several days at a time. Two years ago the State veterinarian said that tuberculosis in cattle was a recent introduction into that State, yet the writer had killed many tuberculous cattle in said State before that man had graduated, or knew anything about the disease:

March 2, 1899.

My Dear Dr. Moore.—I am in receipt of your favor, contents of which I carefully note. In reply I am glad to be able to say that our herd of Jerseys is in fine condition and doing most excellent work. Never better. We, by which I mean all our several families, have used the milk always from the herd very freely, and in every appearance we are, each and all, as hearty and robust as aborigines. In fact, I think we could discount them. I mean, of course, in general health and condition, not in the use of the tomahawk and scalping knife. We have employees who have been with us for years and constantly with the stock and about the stables, and never have we had a case approaching even a semblance to tuberculosis among them. Some of our men, one of them constantly employed in the stables, who have young children, have always used the milk, and I have never heard of any ill effects therefrom. In fact, judging from their activity and lung power, I should say they were remarkably robust and energetic. By the way, I do not hear so much about cattle commissions in this locality as I did once upon a time. But I recognize, of course, the necessity of being watchful in every way; yet I believe there may be great and unnecessary loss in hasty and ill-advised action. I have used the term "milk" in this letter, and I mean by this term to include the entire dairy product, butter and cream.

Very truly yours.

NEW JERSEY AGRICULTURAL EXPERIMENT STATIONS,

NEW BRUNSWICK, N. J., *March* 2, 1899.

DR. EDWARD MOORE, *Albany, N. Y.:*

My Dear Sir.—Your letter of the 1st inst. received. I have to say that we have issued two bulletins on tuberculosis, but regret to say that the edition of one of them, No. 101, is exhausted. I,

however, send you under separate cover Bulletin No. 118. In reference to your question as to whether I have any personal knowledge of a human being contracting tuberculosis from the bovine, I have to say that I have no personal knowledge of such a transmission of the disease.

Very truly yours,

EDWARD B. VOORHEES,

Director.

They had a herd largely infected with tubercle, and Professor Voorhees is one of the ablest writers on agricultural subjects connected with any of our State experiment stations.

ELLERSLIE STOCK FARM, RHINECLIFF, N. Y.

Dr. EDWARD MOORE:

Dear Sir.—Replying to your letter to ex-Governor Morton, will say the fifteen cattle that were killed here in 1893 were from selections made entirely from herds in this country, and not from importations. They had been recently purchased and not bred on the place.

Since the last herd was made up there has been an occasional response on testing with tuberculin, and these animals have been invariably killed.

So far as I can find, there has never been any trouble arising from the use of our milk.

Respectfully,

CHARLES H. ROYCE,

Superintendent.

Dr. EDWARD MOORE:

Dear Sir.—Replying to your inquiries in regard to the contagiousness of tuberculosis, would say that it must have been in my herd for six or seven years. Have never seen any bad effects upon any one who has used the products of the cattle or had the care of them. Very truly yours.

This gentleman has a family of five young children who have used the products of this herd all their lives, and ninety per cent. of the milk-producing animals were infected.

CHATHAM, N. Y., *March* 2, 1899.

DR. EDWARD MOORE:

Dear Sir,—None of the people who ate butter or milk from the cows that were affected with tuberculosis, which you killed, have ever been afflicted with consumption. Of course I do not know who used the butter I sold to the stores, but I do not recollect of but one case of consumption in Chatham during the time I owned those cows, or since then, and I do not think that person ate any of my butter. If I am able to furnish you any further information I will gladly do so.

Yours truly,

ALBERT E. TRACY.

About fifty per cent. of the herd were tuberculous.

FLORHAM FARMS, H. McK. TWOMBLY, PROPRIETOR.

MADISON, N. J., *April* 13, 1899.

DR. EDWARD MOORE, *Albany, New York:*

Dear Sir.—I cannot give you any evidence either *pro* or *con.* Looking back 20 years, the length of my experience with dairy cattle, I cannot recall a single person dying from consumption whose work was connected in any way with cattle or that consumed the milk.

Some four or five years ago, Dr. Austin Peters told me of a case where he hoped to establish a connection between two tuberculous cows and the death of one or two children that had used the milk. At that time the evidence was not conclusive, and I never heard whether continued investigation proved any thing.

I have often asked others, being greatly interested, whether such a connection had been established, but never received an affirmative reply.

Regretting that I cannot be of greater service to you, I am,

Very truly yours,

J. L. HOPE.

Superintendent.

Mr. Hope has had large experience with fine cattle, and was formerly superintendent for Hon. Levi P. Morton.

April 14, 1899.

DR. EDWARD MOORE, *Albany, New York:*

Dear Sir.—Replying to your inquiry, I would state that two years ago my herd was examined by the Connecticut authorities and 13 killed, this including everything that was suspicious. Prior to this the milk had been used freely by my farmer and his family, and one or more working on the place and their families, also in my own household, which, while in the country, includes daughter and her three young children. Since that time the same persons have used the milk, cream and butter, and, to the best of my belief, every one of them is in good health and looks as well as Mr. Crane's family, whom you know. I should say that, including Mr Crane's family, there must have been during the summer at least 10 adults and 8 or 10 children using the products, not including household servants. I do not know of a case of consumption or any indications of it in any of the persons referred to.

Very respectfully yours.

The above letter is from one of New York's prominent financiers, and his herd is one of the best in Connecticut, and, owing to the large percentage of diseased animals, and the number of children as well as adults who have been feeding on their products for a number of years, this evidence is exceptionally strong.

If we have succeeded in purging the bovine of responsibility for human tuberculosis we have severed the relation supposed to exist and which gave origin to the title of this paper. People everywhere will feel relieved. Cattle owners will vie with the cow-milk drinkers and the beef eaters in their appreciation of the fact, that their minds are now freed from the terrible menace that has heretofore haunted them. The cattle industry will receive new impetus. Physicians will have to educate consumptives to appreciate the necessary precautions they should take, nay, they must take, for the protection of their fellow beings, and healthy people must be made to understand in what ways tuberculous subjects are dangerous to them. The imperative need is for meas-

ures for the protection of human from human. Such education will cut down the death-rate more rapidly than medical treatment. The establishment of hospitals and retreats for the treatment and isolation of consumptives is the best step physicians have yet taken for the prevention of the spread of this disease. We are now raising one foot to step up on the firmer ground of the twentieth century, where no erring footsteps have yet been taken. In the few days left us ere we reach that new trysting place, let us bend our energies to the great task of leaving forever behind us old prejudices; theories we were taught to accept, but which have not proved trusty; deductions arrived at from experiments well intended, but which are nullified by better evidence now before us. Let us not look at things as they have been pictured, but strive to see them exactly as they are. If we have failed to convince you, we have at least pointed the way for future investigation and given the earnest of the verdict that is to follow whether you render it to-day or to-morrow.

Household Economy.

By Mrs. Melvil Dewey, Albany, N. Y.

Records of the Pension Bureau at Washington show that there are five widows and seven daughters of soldiers of the American revolution now receiving pensions from the government. So near are we to the days when spinning, weaving, tailoring, dressmaking, shoemaking, brewing and many other industries were carried on in each individual family. To-day the great department store of our large cities may furnish almost every requirement of the home outside of cooked foods. Notwithstanding all the improvements which machinery and centralization of labor have brought, the conditions of our modern life grow more complex yearly. The waste in household methods, the duplication of work in many homes, the long hours of service, and the incompetence of help still confront us. The domestic problem touches every home, from the woman who does her own work to the fashionable society leader who entertains in some form almost daily. What practical steps can be taken to meet the present need? One busy woman with a large house where the latch string is always out has found her cares much simplified by dividing the regular work between two good helpers, and employing a laundress for two days each week, a seamstress or mender for one or more days as needed, a man for furnace, care of walks, piazzas, grounds, washing windows, dressing floors, cleaning brass, beating rugs, etc., and house cleaners as needed. The difficulty is of course in finding competent help.

In all our large cities there is a large class of women desiring employment who are unwilling to go out to service under present conditions. Could they have special training, live at home, and

be employed by the hour, day or week, there are doubtless many who would take up housework could it be invested with somewhat of the professional dignity which surrounds the trained nurse.

We have long recognized that mistresses need special training almost as frequently as maids. A woman may be a genius in music, painting, literature or other arts and be quite unable to organize her own household on regular systematic lines. The executive faculty is perhaps as rare as other special gifts. If we had in our cities employment bureaus which represented every grade of skilled service from the washerwoman to the college graduate, who could go into a home and as an expert organize the daily work according to the individual needs of each family, the value of her special training, instead of being limited to one home, would be many times multiplied. In the library profession there is constant demand for just such expert advice, and graduates of our state library school are constantly called to local libraries to study the conditions and to advise as to the best forms of catalog, charging system, building, number of assistants, etc., required for that community.

The schools of domestic science have made a beginning towards providing skilled labor, but as yet the cost of the necessary plant, as for example in the School of Housekeeping in Boston, is so great compared to the small number who can receive training, that the plan would be prohibitive in most cities. It might be possible to organize such a school with a bureau which could supply skilled labor of all grades, by the hour, day or week, as well as for permanent service. Where young women come from the country or have no permanent homes, the plan often adopted by trained nurses of taking a flat or floor together, or the "bachelor maid's" quarters, would be entirely practicable. If half a dozen ladies wished a good mender one day each week, or a cleaner, parlor maid, etc., the time of one girl would be regularly filled. It would be possible to benefit every class of homes, from the woman who does her own work to the one who entertains constantly. As the number of skilled workers increased, some-

thing like the New England kitchen or department store for cooked foods might be developed, when families were sure that the food thus supplied was prepared under strictly scientific, hygienic and sanitary conditions. This is already being done on a small scale in a mountain club, where the most isolated cottage, occupied by a gentleman under treatment for nervous prostration, has a housekeeper in charge who takes care of the rooms, makes tea and coffee, cooks eggs, chops, steak, etc., and all other foods are sent from the club kitchen ready for the table, or if necessary are freshly heated. The plan has given complete satisfaction.

The state of New York has this year made a special appropriation for establishing a school of forestry, the first in this country, though the need has long been felt. There are already two state schools for training librarians. Is it too much to expect that the coming century will see state schools of household economics, when our need is fully realized, and women have determined to bring science into the home, as it is being brought into all phases of work in order to obtain the best results?

The Bright Side of Farm Life.

By Mrs. G. R. Smith, at Farmers' Institute, Franklin, N. Y.

Doubtless many think a pastor's wife does see the bright side of farm life. She is invited to the farm homes to eat warm sugar, strawberry-short-cake, Thanksgiving turkey or any other thing which is specially nice, and knows nothing of the hard work. All this is certainly a very bright side of my life; but there is no kind of work which falls to the lot of the farmer's wife or daughter that I have not done. From picking up chips—yes, and picking potato bugs, driving cows from the pasture and working grafting wax for father while he grafted his apple trees when I was a little girl—to caring for an invalid mother and doing the work for a herd of ten cows, when milk was set in shallow pans. I've been through it all. I know how tiresome the milk work is on the sultry summer morning when one has enthusiasm for nothing. But even the great pile of milk pans to be washed had a touch of brightness for me. They helped me partly forget my anxiety for my mother, and so they rested me. They have a bright side for you too. It is that you do not use them. Present-day methods of dairying are much easier.

There was a summer vacation later, when Mr. Smith and I ran a little farm of 20 acres and were as happy as kings and much more independent, and left it in the fall richer by the winter supply of fruit and vegetables. So you see I've seen all sides of farm life.

We often lament that we have not as good schools or as long terms as town people. I'm not going to admit that you have not as good teachers as we, for I taught a country school myself for four terms. Afterward I taught in a large town and I found that it took my village pupils ten months of their school year

to do the work that my country pupils of the same age and intelligence had accomplished in six. I was wonderfully discouraged and sought the reasons that I might remove them; but found them almost wholly beyond my reach. In too many cases the town child enters school in the morning tired and listless, because he was out the evening before, on the street or in the stores or pool rooms. He cannot put his mind to his work because it is full of the gossip, profanity and vulgar stories of his evening associates. The mind that is filled with the rubbish of the cigar shop can not hold the pearls of knowledge. On the other hand, the country boy enters the school room as fresh and brisk as the pure country air he'd been breathing all the morning. He goes at his work with a will, because his months of school are so few that he is hungry for his lessons. There is just as much difference between teaching the child who is hungry for lessons and teaching one who is kept at them all the time, as there is between feeding a child who is hungry and feeding one who is eating all the time. There is just as much difference in the assimilation, too. The child who takes his lessons with a relish will appropriate them and use them with vigor; while the one who is crammed, finds his learning only a burden. I believe this one great reason why so large a majority of our eminently successful men in all callings are country boys "grown tall".

For a family home there is no place like the farm. Surely this one thing should go far to lighten any clouds which hang over the life of the farmer and his wife. Our children, the best gifts God sends us have a better, purer, pleasanter home on the farm than we could give them anywhere else. I do not mean that the poorest farm home is better than the best city home. I mean that if you compare your home with the home of a man of your own wealth and ability in the city, the farm home is far ahead every time; and there are some advantages which the poorest may enjoy in the country that no amount of wealth can buy in the city. The room of the farm is no small factor in the problem of a home. When we moved to Franklinville, my little four-year-old boy preceded me to our house, and when he met

me at the door a half hour later with his eyes shining and smiles all over his face, he exclaimed, "Mamma, I can go clear 'round the house." "Clear 'round the house." How much the one sentence told!

Oh! You mothers whose children may run at will over your own broad fields and beautiful hills, imagine if you can the problems of the mother who has for her child's play-ground only a bare, sun-baked back yard, shut in by city walls. This is the lot of the better class of city people, those who pay from $300 to $500 a year for rent. Do you wonder that my children think of grandmother's farm with its orchards and tennis court, its swing and croquet grounds as an earthly paradise?

I know of no other business in which the bright side overlaps the dark so much as in farming. Take the first necessity of life-food. Who ever heard of a farmer with the first particle of push, starving? He may not be able to live on blue points and canvas-back duck, and wear lilies of the valley as a boutonniere the year round, but some form of good food and necessary fuel he may be assured of. New York farmers do not know what suffering is. You are so accustomed to being well fed and cozy that you forget that it is not so everywhere. Six years ago we were living in the heart of industrial Pittsburg, during the great iron strike of 1893-4. I wish I could make you understand what life was like there. Day after day thousands of men in thinnest clothing, with the look of famine in their faces, marched miles through the bitter cold to the "Charity Relief Station," to try for work at any price, only to be told, "Only half of you can work, there is not money for all. Those who work to-day must be idle to-morrow." One dollar once in two days to provide for a family where rent must be paid and every scrap of food and fuel bought! Try it for a week, estimating your rent, food and fuel at prices you receive in market, and you will thank God more truly than ever before for the plenty which surrounds you. Mothers! What would it mean to you to be obliged to send your children to school to keep them warm, because there can be no fire at home; to have to take your baby on the street and beg at the

doors for milk to keep life in the little shivering body? And through all the want and misery, the beer wagons were running and the saloons were bright and warm. No wonder that the despairing men, worn out with tramping the streets for work, aching with cold and half-crazed at thought of the loved ones at home without food or fire, crept into these open doors of hell for warmth and forgetfulness.

In remembering your blessings this shall not be least—the saloon is not on every corner of the country road.

Bird Studv.

By Mrs. A. B. Johnson, Caledonia, N. Y.

No department of natural history surpasses ornithology in attractiveness, and its resources are almost inexhaustible. Birds may be found everywhere. In the city parks and suburban groves, careful observation reveal objects for study even in the depth of winter. The study of bird life is quite as interesting to the older people as to the younger. Surely, every country boy or girl may have as good an opportunity as did Longfellow's "Hiawatha," who—

> "Learned of everv bird its language,
> Learned their names, and all their secrets,
> How they built their nests in summer,
> How they hid themselves in winter,
> Talked with them wher'ere he met them,
> Called them Hiawatha's chickens."

And it is very likely the birds would say as they did to the proud young Indian lad as he journeyed through the forests with his bow and arrow—

> "Do not shoot us, Hiawatha,
> Sang the robin, sang the bluebird,
> Do not shoot us Hiawatha."

There are known to be between 7,000 and 8,000 species of living birds, many rare and attractive, all interesting for study. Of North American birds alone, there are more than 1,200 species. Of this number but a couple of hundred may be called fairly plentiful in the temperate parts of the United States. Birds may be classed as migratory and resident; the former are numerous, spending the winter season in the south and returning north on the approach of spring. The latter remain with us throughout the entire year. Of course, only those remain that can subsist under almost any circumstances, nor do these resident birds have

the entire country to themselves in the winter. There are birds who immigrate from the extreme north, such as the snow bird and grosbeaks.

Many birds of no special beauty of plumage seem far more interesting than those of brighter colors and prettier song to recommend them. Many of the plainer birds have indications of a great deal of intelligence which may be studied with increasing interest. Birds are more musical at certain times of day as well as at certain seasons of year. Between dawn and sunrise occurs the grand concert of the feathered folk. There are no concerts during the day, only individual songs. After sunset there seems to be an effort to renew the chorus, but it cannot be compared with that of the morning.

Just what meaning should be attached to a bird's notes will very likely never be discovered. They really do seem to express nearly every feeling of which the human heart is capable.

There can hardly be a greater pleasure than in watching the nest-building of birds. The intricate work in weaving the beautiful nests of many birds is truly wonderful. Some observers affirm that, like the human builder, the bird improves in nest-building by practice; the best specimens of architecture being the work of the oldest birds. Senses of sight, smell and hearing are remarkably acute in birds; this is especially true of sight. Some have three eyelids, the upper and lower and a membrane that can be drawn down over the entire eyeball, enabling them to look directly at the sun. Eagles, hawks and owls are thus provided. The best method to arouse an interest among the children is to go with them into the fields and groves and assist and encourage them in the study of bird-life as they find it; have them bring in written descriptions. As a guide, use the following points: Shape, size, prevailing color, marks on head, wings, throat, or tail; shape of bill, length of tail, where found, whether on the ground or in trees. When the nest is found, describe its construction, where found and if there are eggs, give the color and markings, number, etc.

It should not be over-looked by the young observer that if he would learn to recognize at once any particular bird, he should make himself acquainted with the song and call notes of every bird around him.

Many birds bear names given them by their own peculiar cry. Listen: "See-see Dick, Dick, cissel cissel. You call me the little meadow lark, while all the time I am trying to tell you as plainly as I can what my name is; to tell the truth I don't belong to the lark family at all. Simply because I wear a yellow vest and a black bow at my throat does not make me a lark. You can't judge birds any more than you can people by their clothes. No, I belong to the finch or bunting family, but I am called the Dick cissel."

Who is that little fellow we may see frequenting the wood land when it is not too wet, his note is about the only one heard at noonday, during mid-summer. "Teacher, teacher, teacher, teacher, teacher," is it some child-voice calling his teacher. No, it is a species of thrush, commonly called the "Teacher bird." It is also known as the oven bird, the name being derived from its peculiar nest which is fashioned like an oven.

The preceding may be considered the sentimental part of bird life; we will endeavor to speak of something of economic value. Every one knows in a general way that birds render most valuable service to the farmer, both in the field and in the orchards. Investigations have been made to determine just what such services are. Results have been striking and can no longer be ignored. In many places some of our sweetest songsters and most useful insect destroyers have become scarce or have entirely disappeared. The great value of insectivorous and granivorous birds cannot be overestimated. Thus, while the chickadees, woodpeckers and other winter birds are ridding the trees of insects, eggs and larvæ, the granivorous birds are reaping a crop of weed seeds, which left to germinate would cause a heavy loss to our agricultural interests. The fact is evident to all who have given any attention whatever to the subject that if the cruel and use-

less slaughter of birds is not soon checked there will be obliteration from regions where in former years they were abundant.

This is true of the humming-bird, blue-bird, wren, common quail and ruffled grouse; also the heron, pelican and many smaller birds of Florida. The causes are many but the greatest is thoughtlessness on the part of young and old of both sexes. Tommy wants a gun—he teases persistently until his fond parents finally submit and one is procured—Tommy tries his marksmanship, result: he shoots all the birds he can in his vicinity.

Collectors of eggs are also responsible. Forest fires are another source of this destruction and many of these fires are known to be the work of incendiaries. Fashion at present, is the greatest enemy to bird life; when the ladies need new bonnets nothing else will do for adornment; though 10,000 sweet songs be hushed forever. The killing of the white heron, for example, to procure the much prized aigrettes for millinery purposes. By far the life of a greater number of these birds are sacrificed during the nesting season, when their plumage is brightest. It has been known that the slaughter of marsh and maritime birds has been followed by an increase in human mortality among the inhabitants of the coasts, the birds having formerly assisted in keeping the beaches free from decaying animal matter.

Not many years ago, New Orleans had a plague of bugs, just as the yellow fever began, and strange as it may seem the bugs proved far more troublesome than the disease. People called it a mystery. Scientists declared it was merely the result of man's improvidence in destroying the birds. Nature surely had revenged herself on New Orleans.

There is no bird that can compare with the chickadee in destroying the cankerworm moth. It has been calculated that one chickadee in one day destroys over 5,000 eggs. A certain man attracted chickadees to one of his orchards, feeding them there in winter, and he says: "that in the following summer while trees of the neighboring orchards were seriously infested by cankerworms and caterpillars, the orchard where the chickadees had been, no serious damage was done by the worms or caterpillars."

The Baltimore Oriole or golden robin, is remarkably familiar and fearless of man, hanging its beautiful nests in our garden trees. He is one of the most interesting features of country landscape. In the spring the oriole's food consists almost entirely of caterpillars, beetles and other insects that injure the trees and fruit. There are few birds that do more good in this way. Though sometimes they eat our grapes from the vines and peck at the fruit on the trees, it is usually because they want a drink that they do this. One good man placed pans of water in his orchard, and he soon noticed that not only the orioles, but other birds came to the pans for a drink instead of disturbing the fruit.

All woodpeckers, of which there are many varieties, are of vaule to the farmer. About three-fourths of their food consists of insects, wood-boring beetles, many caterpillars, mostly those species that burrow into trees, and many ants that are particularly harmful to timber, these insects not being accessible to other birds, are sought after by the woodpeckers, whose beaks and tongues are especially fitted for such work, dig out and devour them.

If the farmer only thought of it, he would begin to think that part of every corn crop rightfully belongs to the blackbirds. When the corn is young he cannot see the grubs, but the birds can and they take many thousands in a day. These birds have been much abused on account of the farmer not knowing that they actually more than compensated him for the mischief seemingly done, by the benefit they confer in the destruction of grubworms and other deadly foes whose secret work destroys vegetation.

The robin—often called "morning bird," glad harbinger of spring, wakes us with his warbling early in the morn. This bird courts the society of man following closely upon the plow spade and hoe. To be sure he feeds for a month or so on our strawberries and cherries, but his general diet is that of insects and worms picked out of the ground. He destroys the larvæ of many insects in the soil and is a positive blessing to mankind.

In regard to larger birds, which are called birds of prey, such as the owl, hawk and crow, the uninformed farmer considers them his enemies, but nearly all species render great service in destroying many field mice and ground squirrels and other small rodents, harmful to vegetation.

Some writer has said, "if all the birds should die, not a human being could live on earth, because the insects upon which the birds subsist would increase so enormously as to destroy all vegetation and that birds save for agricultural purposes alone annually, $100,000,000 in the United States."

Can one imagine a summer time without the songsters! No happy morning song to greet the early riser, no sweet melody to cheer the plowman as he enters upon his daily task, no bright-tinted object, fluttering through the leafy boughs of bush or tree!

Let us cherish these winged creatures as gifts from an all-wise Providence, for without them the world would be more barren than we think.

Would it not be a good plan to increase the intelligence of the present and rising generation respecting the value of birds, by introducing into our schools the study of bird life. Through the wise co-operation of our school boards suitable text-books may be procured which will supply the knowledge needed in regard to the great value of these often-abused creatures, and arouse an interest in their protection. The Audubon Society of the State of New York, which was formed February 23, 1897, together with other societies, have done much to prohibit the useless slaughter of these feathered tribes. But the universal custom of wearing birds and their plumage is of too long a standing to be changed in even a few years; it must come through education, a knowledge of their great value to the world. The Audubon Society found already laws existing, if enforced, adequately to protect our birds. The Audubon pledge does not prohibit the use of ostrich plumes or the feathers of the domesticated fowls.

Let us, fellow teachers and fellow citizens, take up this work of bird study and protection. Let the schools teach it, let the

press print it, the pulpit preach it till from thousands of happy throats, shall be proclaimed the glad tidings of good will of man toward the birds.

"T'is always morning somewhere and above
The awakening continents, from shore to shore,
Somewhere, the birds are singing evermore."

Nature Study.

By Anna McPherson, Garbutt, N. Y.

This subject has a wide range and time will not permit any discussion regarding its early history under Froebel, and its evolution in America, until to-day the American kindergarten leads the world in its methods of following nature in the education of children.

We shall talk of nature study in our common schools, and its practical value to the farmer. Farmers in general recognize the fact that agriculture is of vital importance among the industries, and realize that they must understand the natural elements with which they have to deal and the best methods of exterminating or resisting the attacks of injurious insects which are rapidly increasing, both in number and variety. (Professor Slingerland says at the rate of 7,000 new kinds per year. The United States have 33,000 out of a total of 300,000 known varieties.) Had these subjects been taught in our country schools fifteen or twenty years ago, the farmer of to-day would be better prepared to meet the difficulties now confronting him. Farming has indeed become a science, and a successful farmer or fruit-grower of to-day requires a much broader education than in most lines of occupation which we might mention. A country child is in nature's laboratory with all nature about him, and as the average student's school life closes at fourteen or sixteen years of age, why not begin his education in childhood and thus develop a love for farm life and agriculture. While in our country schools the common and frequently higher English branches are taught, it is astonishing that little or no instruction is given that will aid in a practical manner those wishing to follow this branch of in-

dustry. Our educational system, excellent as it is in some respects, could be made of greater value by helping the student to obtain a knowledge of the forms of life about him through observation and personal research, thus arousing his dormant capabilities and securing the harmonious development of all his faculties, often giving an incentive to further study.

It seems to be the fad now to make the child appear "smart" rather than "substantial", and through a system of cramming a superficial knowledge of books is obtained without knowing how to put it to practical use. They have not learned to do by doing. It is not enough to learn the principles of mathematics and science, but we must know how and where to apply those principles in our avocations. Childhood is naturally active, observant and inquisitive. Children see many things in the natural world they do not understand, and are continually thirsting for knowledge. Do we recognize this in their education? Do we realize its significance and encourage them to develop powers of observation? We do not! From his earliest school days books are placed before the boy, his memory alone is trained until nearly over-burdened, while his eyes and ears are left to train themselves, with the result they are gradually closed to the wonders and beauties of the natural world, and he steps forth only partially equipped to take his position in the struggle of life.

Ruksin says: "There is no moment of any day of our lives when nature is not producing scene after scene, picture after picture, glory after glory, and working still upon such exquisite and constant principles of the most perfect beauty that it is quite certain it is all done for us and intended for our perpetual pleasure." Not many of us see these masterpieces nature places before us, because our eyes have not been trained to habits of observation. No one can appreciate the works of nature without knowing nature, and to know her you must get nearer to her and study how she works. A student, boy or girl, who has learned to observe and can describe correctly so apparently as simple a matter as a leaf, insect or bird, has learned the art of accurate

and rapid observation, which will be of infinite value in any position in life.

For instance, take it on the farm. It is not the big burly boy or man who can perform prodigious feats of strength, breaks all the handles in your pitchforks and smashes things generally, breaking more implements than he's worth, who is in greatest demand and receives the highest wages. Rather, who does not prefer the one who works intelligently with his brain, eyes and hands in harmony; who does not have to be told twice how to do a thing, but comprehends immediately and does it; nor stops five minutes to *think* before he can *see* what he is doing; who, when sent to the garden to hoe the weeds out will not also root up all the vegetable plantlets, never having noticed the difference between vegetable plants and weeds in their first stages of growth? Yes, we've all seen just such *help*. Intelligent help on the farm is getting scarcer every year, yet what men we are obliged to hire demand the same wages a skilled laborer is entitled to. In nature study we have a remedy.

Not only on the farm, but in any position, be it messenger boy or bank clerk, the one with a quick observant eye is better equipped for positions of advancement, and the one not so endowed must cultivate the habit if he wins success in life. The Indian who roamed through these trackless forests before the advent of the white men had so trained the eye for generations, that they were able to tell from an indistinct footprint how many hours had elapsed since the foot had pressed the ground, and could follow the trail for miles, which to a white man's eye showed not the faintest trace. You have heard of the man traveling in the Orient who lost his camel. In his search for the animal he met an Arab of whom he made inquiries for the missing beast, but he said he had not seen the camel. After further conversation the Arab asked the traveler if his camel was lame on its left hind foot, blind in its right eye, and carried meal in its pannier. The traveler answered yes, then you have seen my camel and can tell me where he may be found. The Arab said

no, I have not seen him, neither do I know where he is, but as I came this way I noticed birds of the air picking something from the ground which I found to be meal, the footprints showed me a camel had passed this way, and the impression from the left hind foot being indistinct I knew he was lame in that foot. I also saw that the grass on the left side was cropped close, while that on the right was untouched; from this I knew he was blind in his right eye. All these signs the Arab had observed and traced, and though equally plain to the traveler, he had not seen them, and could hardly be convinced the Arab spoke the truth. We thus see the value of natural science, which has been defined as "consisting of two things, seeing what you look at and drawing proper conclusions from what you see." Not only in country, but in city schools is the need for nature study felt. A recent paper states:

"At an examination in many of the public schools in Boston, Syracuse, Kansas City, St. Louis and other of the larger cities, a surprising ignorance of natural objects was shown; very many of the children had never seen a bee hive, bee or a hen; did not know what a snake or a toad looked like; could not describe an insect, and had no idea what a butterfly was. It was recommended that some of the subjects now taught be dropped and nature study substituted."

How many children of the age of twelve or under, can tell a bass wood tree from an elm, a cherry tree from a maple with the leaves on or off? What appears first on a fruit tree, the leaves or blossoms? Why can a fly walk on the ceiling? How does the grasshopper sing his song? How many teeth has a cow on its upper jaw? How many teeth has a hen? You laugh at this, but I doubt if one child out of twenty can answer these questions correctly, yet they are subjects which are met with every day. As our prosperity depends in so large a degree upon the cultivation of the soil and plant life, why should not our boys and girls be educated to a knowledge of nature by bringing them into direct contact with her work. Make nature study real and personal; teach the children to know the plant, its habits, its family, and its enemies by actual observation, so they may be able to tell

a pumpkin plantlet from a burdock or a radish plantlet from a rag weed. You think you can do so now? Well, perhaps; try it this spring. A young lady was given some very small verbena plants in their second leaf which she carefully planted, tenderly watched over and watered, anticipating great pleasure in her verbena blossoms, imagine her disgust when she found all her care had been bestowed upon catnip plants. Now suppose we study the little plants this summer so we may be able to detect the difference in the several varieties of seeds and plants and not raise a crop of something we do not want.

I recently heard of a bicycle party on a country run who were very much attracted by a beautiful plant they saw growing in a garden. This plant had tall stalks of dull green over topped with silvery bloom. Every one halted to admire the beautiful plant with exclamations of delight. Finally one of the party asked the "man with the hoe" who was at work near by what those beautiful flowers were. He looked around in surprise, then asked her what she meant. Why! those lovely plants along the fence. I never saw anything like them before. He smiled a pitying smile as he replied: "Them! Why them's onions gone to seed."

Children are enthusiastic admirers of trees, tell them their names, habits of growth, what makes them grow, length of life, when the buds and blossoms appear, when and why the leaves fall. Tell them of its countless enemies which destroy fruit and leaf. Teach them how to recognize these insects, their nests, eggs, etc., so as to destroy them. (Those are the nests the small boy would more profitable destroy than the helpful birds' nests.) The practical results of this method is demonstrated in California's rich fruit belt, where entomology is required in the schools and the children are actively engaged in destroying the pests. If such a method were adopted in New York the tent caterpillar nests would not be found in nearly every tree and orchard along our highways, a blot upon the landscape and a menace of what we may expect from the same quarter next season. Our forests also suffer from the depredations of insects.

Entomologists give between 500 and 600 distinct species that attack the oak, 100 the elm, nearly 200 the hickory, over 125 the willow, nearly 200 the pine and hundreds the other evergreens, over 100 the maple. During the past year the depredations of insects in many localities have been so destructive that the farmers are obliged to cut down their beautiful maple groves, being a loss of many thousands of dollars to them. We have many faithful allies who will help us in destroying this vast horde of insect enemies if we will but recognize and protect them. All insects are not injurious, some are beneficial and we should be able to discriminate. Then come the birds. Who does not love the birds and welcome their cheerful inspiring song when they return in the spring!

In portions of Alaska there are men, women and children who never heard a bird sing (imagine it if you can) and their delight was unbounded when they first heard a canary bird warble. The birds are man's best friend; without them the earth would be uninhabitable. Thus we should teach the children they are to be protected, not alone because of their beautiful song and color, but by a wise Providence they prevent the undue increase of insects, destroy noxious weeds and in many other ways are helpful to the agriculturist. They should not be stoned, hunted or destroyed in any way, the victims of small boys and boyish men who think it manly to take life merely from love of sport. Instead of buying a gun take the money and buy a field glass and study the habits of birds and animals about you, and I'll venture to say you will get more real, pure pleasure from that kind of sport.

Snakes and toads are interesting objects of nature study and should also be protected as being of value to the farmer. There are very few poisonous reptiles in our section of the country and we should discourage the killing of harmless snakes which are really as valuable as the ungainly and useful toad. Insects form their article of diet; cut worms being a favorite dish. On the whole they are beneficent creatures and our prejudice against

them is rather the result of their evil look and reputation, together with our ignorance in regard to their utility.

Moles and skunks are also friends of the farmers which are being exterminated through ignorance of their usefulness. A study of their habits, food, etc., would furnish an interesting field of observation and result in much benefit to the agriculturist. If all these allies were protected as they should be, they would not be obliged to spend so much time and hard-earned money on insect poisons, etc., as they are now doing.

A clever teacher may take up nature study in our schools, without its being an added recitation. To begin with make it a rest exercise once or twice a week and give such subjects a wide range of adaptability from the primary to the highest grades. Do not stop during the winter months, there are always objects awaiting our investigation. As soon as a genuine interest in nature study is awakened in the children and teachers, you will be surprised at how many interesting objects the pupils find to bring in for study, and cabinets of plants, insects, and minerals will be formed, all which will be of benefit not only to the pupils, causing them to take an interest in farm life such as they never had before, but interesting also to the parents who never had these privileges, and to whom the child rehearses the new things he has learned during the day. The book of nature once open to him, the printed page will be more interesting and an appetite awakened which will be satisfied only with wholesome food, and the weak, harmful trash found on the news-stands, will be voluntarily rejected. Over and above all, in this study of nature the student will be led to see the marvelous symmetry and minuteness of finish, in the very humblest of plants and animals and will be constrained to love nature and reverence nature's God, thus morally elevating and uplifting to nobler, higher aims.

Let the farmers urge on and assist in every way possible that the study of nature in our common schools may become popular. When anything becomes popular we may look for success. Thus we may easier obtain intelligent help. The farmer's boys and girls will learn to love their home and farm life, the city have

less attraction for them, and the farmer's family will be raised intellectually to a higher and more prosperous plane, and be able to keep pace with the progress of civilization, and thus be in a position to take their proper place among the learned professions. The terms "hayseed" and "clodhopper" will be applied no more to the American farmer.

"Nature never did betray the heart that loved her,
'Tis her privilege thro' all the years of this our life
To lead from joy to joy;
For she can so inform the mind that is within us,
So impress with quietness and beauty
And so feed with lofty tho'ts
That neither evil tongues, rash judgments
Nor the sneers of selfish men,
Nor the greetings where no kindness is,
Nor all the dreary intercourse of daily life
Shall ere prevail against us."

I understand Cornell University has established summer schools and prepared papers on nature study for teachers so as to qualify them to develop the latent powers of observation in their pupils. The state normals have neglected to include this among their methods which we trust they will do in the near future. Would it not be a wise plan for every one who can spend but ten or fifteen minutes each day in reading, to send for these papers (they may be had for the asking) and study one of the most important sciences of the day.

Unseen Opportunities.

By Rev. F. W. Moot, Johnstown, N. Y.

We are living in a wonderful age. We cross the continent or the mighty ocean in five days; we talk with a friend a thousand miles away and recognize his voice; within an hour we can communicate with almost any portion of the civilized world; we travel, we read, we warm ourselves by that mysterious agent, electricity; an event occurs in South Africa and within three hours the newsboys are selling for a cent, printed newspapers containing an account of the affair. When we pause and look back two, four, five or ten centuries at the conditions and inconveniences of our forefathers, and then at all the wonderful achievements of the nineteenth century, we are tempted to believe that we are living in another world or, at least, under some new laws of nature. But we are not. This is the same old earth, and the laws of nature are the same as when man first saw the light of the sun. There is but one thing that makes this age so marvelously superior to any other—the men of this century have *seen* what was *unseen* by their ancestors.

There is but one reason why Christopher Columbus did not cross the Atlantic ocean in a steamboat instead of his sailboat—men did not then see the power in steam which had ever been open to their investigation. It remained an unseen opportunity until Watts and Stephenson and Fulton put it into practical use. There is but one reason—the unseen opportunity—why the Magna Charta, which was signed by King John, of England, June 15, 1215, was not printed the next morning in a daily newspaper. The act of writing had been known for ages, but the opportunity in movable type was unseen until 1438, when Guten-

berg presented it to the world. The defeat of the heroic band of Spartans at the pass of Thermopylæ, 480 B. C., might have telegraphed to Sparta, only that the possibility of sending a message over an electrified wire was unseen until 1844, when Prof. S. F. B. Morse sent the first message which marked a new era in the histotry of civilization. Our forefathers might have had the moving machine, the threasher and cleaner, the sulky plow, the graindrill, and a hundred other convenient farming utensils. They had wood and iron and knew how to work in these, but they failed to see how to put these together as men of later date have discovered.

Not only in invention have men failed to see their opportunities, but in every vocation and calling of life there have been golden opportunities which had we seen and improved would have resulted to our great advantage. Some of these may be beyond the penetrating power of our vision, but hundreds are lying all about us which may be seen, and which if improved will improve the condition of any preacher, lawyer, merchant or tiller of the soil.

In this age of multi-millionaires, there is a widespread desire among men to become rich. Wealth honestly gotten and rightly used is a blessing, and this rule applies to man whether he has twenty thousands or twenty millions of dollars. It is not *money* that is the root of all evil, but "the *love* of money is the root of all evil." The desire for a large competency has found a resting place in the bosom of many a tiller of the soil, but in the process of his way of farming and the hardness of the times he has not realized his fond hope of wealth. Perhaps to-day in his despondency he has concluded that if he ever is going to be rich, or does not desire to end his career in the county almshouse, he must get off the farm, for there is no money in farming. But before any man leaves his farm to make a larger competency in the world, it will be wise to sit down and count the cost. Many a farmer who left the farm to gain wealth in the world has years afterward discovered that he and his fortune separated when he moved off the farm. I have known some remarkable instances

of this character. Several years ago a man was living on his farm in Pennsylvania. His brother in Canada sent him word that he had discovered coal oil and thought he would make a fortune. The brother in Pennsylvania sold his farm for $833 and went to Canada to make a fortune by finding coal oil. He did not find it. But the man who purchased the farm for $833 discovered coal oil on this very farm which his predecessor had deserted, and the total value of oil taken from that farm is estimated at $100,000,000.

A farmer in California learned in 1850 that some one had discovered gold a few miles south of him. He sold his farm and hastened to the new gold field to make a fortune. The man who purchased the farm built a mill on the bank of a stream which flowed through the farm. His little daughter took some of the sand from the stream and carried it to the house. One day while she was letting some of this sand run from one hand to the other her father saw some bright glittering particles in the sand. He examined it and found it to be gold. That farm has grown to be one of the richest gold mines in California from which over $129,000,000 worth of gold has been taken. Your farm may not have hidden in its bosom coal oil or gold, but it may have treasures which proper tillage may unfold.

Some seem to think that money can be made only in the large cities. But a census of 107 millionaires in New York city in 1889, revealed the fact that only eight out of the 107 had made their first million in New York. The other ninety-nine had made their first million in some small town or city. There are farmers who have been and are making money on the farm, but they are those who are improving what to many others are "unseen opportunities."

In your marketable produce study to learn what people want. Some people seem never able to learn that the public will not buy what it does not want, but will buy and pay a good price for what it does want. Some merchants compain because they do not have what they believe is their share of patronage. If they deal honestly and get what the public wants, patronage will come.

A. T. Stewart is said to have begun his career with $1.50. He invested 88 cents in articles that people would not buy because they did not want them. In this experience he learned what they did want, and invested his remaining 62 cents in these and easily and readily sold them at a profit. All his life he acted upon this principle and died leaving a fortune valued at $40,000,000. John Jacob Astor in his early life closed a mortgage on a millinery store in New York because the parties could not pay the interest. However, he retained them in the store with instructions to take apart all their made-up goods which were unstylish. He then went out into Central Park and when he saw a beautiful, stylish hat he went directly to the store and had one made like it and placed in the window. This he did until the store was full of stylish hats that ladies wanted. The result has been that the profits from that store have amounted to over $17,000,000.

A farmer in Indiana had a great many fatted hogs which he could not sell at any price. He went to Boston with his wife, resolved if he could find anything to do he would give up his farm and hogs, which nobody wanted. While in Boston he saw canned gooseberries selling at 60 cents per pint. He hastened back to his farm, sat out gooseberry bushes, and began the culture of berries, canning them within two hours after they were picked, that they might retain their freshness and tart. His gooseberries were sold in New York for 75 cents per pint and to-day he is one of the largest taxpayers in Indiana.

An old man lived on a small farm in Vermont and each year tapped a maple tree in front of his house, making a little syrup from the sap. After 40 years of life on this farm he was still poor. One day while making some maple sugar he made it into maple crystals. They were so delicious to the taste that he interested some large maple-sugar manufacturers in the scheme and in eight years was worth $280,000. "Unseen opportunities" in learning what the public wants.

A man living in Boston was paying 12 cents per quart for the milk used by his family. One day he learned of a milk dealer

that he was selling his milk for six cents per quart. The man went home and ordered his wife to buy her milk of the six-cent-per-quart dealer. She did so. The first morning it was poured into the coffee, the husband drank his, but the wife only tasted of hers. The next morning the husband drank only part of his, the wife's was untouched; but they had saved six cents. The next morning neither of them used any milk, but the husband lifted the cream pitcher to his face, and smelled of its contents. He set it down and said: "Wife, after this buy your twelve-cent milk." He afterward learned that the stables of the six-cent dealer were filthy and his care of his cows and the milk unclean, while the other groomed his cows, allowed no manure to remain in the stable, and in every way exercised the greatest care, that his milk might be of a superior quality. He made money, knowing there is always a class of people who will pay a good price for a superior article.

Mark you, you never will succeed in selling wormy apples, small, diseased potatoes or blue milk. The majority desire pure and excellent quality. "Old Abe" was right when he said: "You can fool all the people some of the time, and some of the people all of the time, but you cannot fool all the people all the time."

Know the cost of production. In the commercial world every man knows the cost of his goods from a locomotive down to a pin. It is the basis of success; it is the indicator of profit and loss, of fortune or failure. Strange, is it not, that with this object lesson before them nine-tenths of our farmers do not know the real cost of their produce, and when they sell do not know whether in reality they have made or lost money. It may be easier for the merchant, who buys his goods by the dozen or gross, to ascertain the cost of each article, than for the farmer, but it is no less important that you should know the cost of your products.

A little common sense and a little system will help you very much. For instance, in your hog-house build a bin with parti-

tions for different kinds of grain. Put in a convenient place a small note book with a pencil tied to it. When you buy six pigs for $2 each, put it down in the book. When you put ten bushels of corn, or other grain in the bin write it in the book, with its market value. You need not keep account of the milk you feed as it has no market value. In the fall when you sell your pork, you can tell in a very few minutes whether or not you have made anything. If you have fed the hog $16 worth of grain, and only received $12 for it, you better stop raising hogs and sell your grain. The same plan can be used with the hens, and to a satisfactory degree in testing the worth of individual cows, weighing or testing otherwise the milk. You should know what your potatoes, corn, hay, etc., costs, that you may often chose the more profitable crop. Rotation of crops is necessary, but sometimes you can chose between two or three different grains in the rotation.

Study economy in production. The farmer cannot regulate the market price, but he can to a large degree regulate the cost of production, which means to him a larger profit. An Ohio farmer had raised potatoes for several years in the old way of cultivation. One day he decided to plant his potatoes with a potato planter, cultivate them with a cultivator, dig them with a potato digger, and store them in square bushel boxes to save time and expense in handling. He did so and reduced the cost of production one-third.

In 1897, at the New York State Experiment Station, two plats of potatoes were planted in the same field. Both were cultivated exactly alike, except when one was hilled, the other was left level. The value of the crop from the latter cultivation was $24 per acre more than on the plat where the potatoes were hilled. It is more economical to keep one $50 cow that gives 40 pounds of milk per day, than two $25 cows which only give 20 pounds each per day. Learn the food-value of that which you feed your live-stock. For one cent you can buy a postal card on which to write your address and send it to the Department of Agricul-

ture at Washington, and they will send you a pamphlet telling the food-value of the various products of the farms.

Sell when your produce brings a reasonable profit. If you know its cost you will be able more intelligently to dispose of your crops. There is some perishable produce which you must sell for what you can get, but nonperishable produce, such as hay, grain, etc., can be kept until it brings more than it cost to produce. But don't be foolish and want an unreasonable profit. This has been the mistake of too many. I know of a farmer who had some pork which had cost him about $5 per hundred-weight. He was offered $9 per hundred-weight, but would not sell. This was in the month of March. He kept his pork until the following October, when it had cost him about $10 per hundred-weight and then sold it for $7 per hundredweight. I knew of a farmer who had 16,000 pounds of hops, which had cost him about $1,600, and for which he was offered $16,000. He refused to take it. Afterwards sold them for about $2,000. I know of another farmer who in the last twenty years has had opportunities to sell his large hop crops at prices which would have made him worth to-day, $500,000. But he is not worth a dollar, simply because he was not willing to sell with reasonable profits.

Give the boys and girls on the farms a chance to have something of their own and by which each year they can accumulate a little money. If they expect to spend their life on the farm, try to give them an opportunity to learn in some agricultural school the more intelligent methods of farming. Always bring them to the Farmers' Institute, even if you have to keep them out of school for a few days. Go home to put in practice many of the excellent things that have been said at this institute. The power that willeth to do is the strongest power in the world. A sick woman was supposed to be dying. The funeral arrangements had been made, when she overheard someone saying the funeral would be on Friday at 2 p. m. She lifted her head from the pillow and said, "There won't be any funeral here on Friday." There was not. The next week she arose from her bed and lived

twenty-five years. When Napoleon wished to carry his army into Italy, his generals said, "The impassable Alps." He replied, "There will be no Alps." And there were none to his indomitable will; for over the icy glaciers his soldiers dragged their cannon. Old Commodore Vanderbilt, when asked for the secret of success, said, "Secret? There is no secret. Intelligently attend to your business, and go ahead." Go home to see your opportunities and to improve them, and *you* will succeed.

The Church and the Grange.

By Rev. JOHN KINCAID, Rodman, N. Y.

When asked to prepare a speech or a paper for this Farmers' Institute, the first and most difficult question to decide was "What shall it be about?"—trusts and expansion, Dewey and the Fillipinos, the Boers and the Transvaal—these are hackneyed subjects. They meet us in big headlines in the newspapers every day. The farmers, I thought, will want a rest from this class of questions. Of soils and siloes, blooded stock and sugar beets, Bohemian oats, orchards, meadows, grains and taxes, what is a preacher supposed to know? But there is one subject I have noticed which is of interest to everyone. Talk about politics and some will turn away in disgust. Talk of religion and some will yawn. Expatiate on the beauties of art and the blank look on the faces of your auditors may betray their lack of appreciation. Speak of business and the idler is unconcerned; expound science and many are bored; but talk to people about themselves and they are all ears. If a man be honest, he must confess that of all things which the Lord has made in the earth or the waters there is nothing of such absorbing interest to him as *himself*. It has been said that the greatest bore in the world is he who persists in talking of *himself* when you wish to talk of *yourself*. So I decided to say something about *ourselves*. Hence my subject, "The Church and the Grange." You represent the grange, I the church.

This is an age of fraternities, guilds and associations. Never since the Lord formed the first society, by putting the hand of Eve in the hand of Adam, has there been such a multiplicity of unions, fellowships and fraternities as at present. I heard a

minister say, a short time since, that he belonged to seven different fraternal associations. I have been wondering since how, amid them all, he found time to kiss his wife or pray to his God. You, my brother grangers, represent one of the youngest of these fraternities and I one of the oldest; and together we represent two of the best. It is well that age and youth meet often. Each needs the other. In mutual respect and confidence they will find mutual profit. Every organization that has any excuse for being at all exists for a purpose. Life is too brief, its fleeting days are freighted with issues too grave for earnest men and women to band together merely to pass a pleasant hour in mirth and feasting. Their social pleasures are best promoted and most enjoyed when hand and hearts are united to forward some good cause. The society that endures and retains its place and influence in the world must stand for something. That its members are friendly, its gatherings inspired by mirth and good cheer will not alone give it an influence that is permanent. Associations that live only to minister to the present enjoyment of their members are ephemeral and soon pass away. Those continue and fasten themselves more deeply in the affections of the people, as the years go by, which embody in their principles and practices some one or more of the vital needs of the world.

The glory of the associations we represent is that they each exist for a definite, well-defined and noble purpose. Each represents an actual need of society. Each has specific ends to fulfill, the accomplishment of which will make the world better and happier. Looking in the Standard dictionary for the definition of a grange, I find it is "a lodge or local branch of the order of the patrons of husbandry, an order designed to promote the interests of farmers and to bring the producer and consumer nearer together." The interests of farmers and the welfare of the nation might almost be said to be identical. A nation's status among the nations of the earth is indicated by the degree of intelligence, industry and sterling character of those who till her soil.

In the welfare of farmers all are concerned. All, then, have reason to watch with no indifferent eye the work, progress and efficiency of the grange. To it a great work is committed—to see that farmers hold their own in the fierce competition of modern days; to seek an influential voice and vote in shaping legislation affecting farmers' interests; to stimulate each other to a broader culture, a wider and more intelligent outlook upon the great world and its conflicting interests; to make the farmer's home a center of refined and wholesome influences; to apply the ever-increasing knowledge of nature and her laws to the practical art of coaxing a world's sustenance from mother earth—surely these are reasons enough to justify the existence of a farmers' alliance. For purposes no less distinct and no less important does the Christian church appeal to the world for sympathy and support. To it is committed the mission of keeping the soul of man in touch with his Maker. History demonstrates the need of religious truth and religious instruction for the highest and best material prosperity. The church, the school-house, the farm—they are three indispensables to Christian civilization.

Now, for the best development of our respective interests, my farmer friends, I urge the importance of mutual esteem, sympathy, and so far as is practical and proper, co-operation. You have your distinct mission (a noble one), to promote the material and social interests of farmers. The church has its mission to all mankind (a sacred holy one), to bring the motives of the unseen and spiritual world to bear upon the hearts and consciences of men. Let us distinguish between things which differ. The church is not designed nor adapted to promote the welfare of farmers as distinct from other classes in society. Neither is the Grange designed nor adapted to take the place of the church in the promulgation of religious truth. Each organization will prosper and succeed as it adheres faithfully to its own sphere of action. One of our humorists, Josh Billings, has a lecture on milk. He begins by saying that he has read quite extensively on the subject in books and periodicals, but with all his research, the best thing he ever found on milk was—cream. The best

thing we shall ever find as the result of the influence and efforts of any organization, is the results that it is designed and is by nature fitted to produce.

Being entertained a few weeks since at the home of a granger in a neighboring town, the conversation turned on the work of his grange. Among the questions which had been discussed there was this—"Resolved: That the Grange is doing more for the moral elevation of society than the Church." Some reliance had been placed upon one who himself never attended church, and was not a religious man, to support the affirmative. To the surprise of many he had very little to say and that little expressed his aversion to that class of questions. He said there could be no doubt in his mind, which had done the most for the good of mankind,—it was the church. More than that, he asserted that the church was the mother of the grange. If there had never been a church there would never have been a grange. It would do for him to say that. Being a minister, I should not wish to say it (although I might believe it), especially before a gathering of farmers. But is not such a comparison unnecessary and invidious? It engenders antagonism where there should be mutual good will and co-operation. There is no natural animosity between the church and the grange. The success of one in its own legitimate line of effort, only renders easier and more promising, the work of the other. If the daughter can outstrip the mother in any honorable undertaking, well and good. But let her be careful how, in the self-complacency of youth, she disdains that mother and seeks to get along without her. The field is wide enough. Hand in hand we should move forward each in his place with charity and good will to fulfill our mission. Much we have in common. Many objects of endeavor enlist alike the grange and the church. The great problems of our times appeal to us both as grangers and church members. The saloon, one of the blackest spots on our civilization, awaits our united action to banish its legalized temptations from our boys and young men. The congestion of population in the crowded cities presents problems which are of vital interest to us both. The growing power

of consolidated wealth threatens the progress of Christian effort in our churches, as well as the success of the principles and objects which the grange seeks to attain. On these and many other kindred subjects, the grange and the church are in touch and in sympathy. Let us foster such a spirit of mutual respect and fraternal feeling towards each other, that as one by one these questions come before us for solution, the influence of our powerful organizations may be thrown unitedly upon the right side.

In their religious views the members of the order of the Patrons of Husbandry are probably widely divided. There are, I suppose, among your members, representatives of most religious sects and many of no sect and no positive religious belief. But on all great moral questions, those touching the sanctity of the home, the purity of the ballot, and freedom of conscience, you are, I take it, practically agreed. The church looks to you grangers with desire and expectancy touching these questions. It has a right to hope that on all issues calling for true moral discernment and decision, those whose occupation brings them so near to nature's heart will be allies of the church in seeking the purity, integrity and justice enjoined by nature's God. Manhood is the great need of the age. A manhood which rises above sect, and party, and selfish greed. A manhood which scorns the man, the uncharitable, the petty and the vile; that seeks not a life of ease through public preferment, but chooses a strenuous life of noble toil and sacrifice looking to the advancement of truth, justice and liberty for its richest reward. Where shall we look for the nurture of such manhood if not among those who, in the independent life of the farm, far from the temptations and vain show of the crowded metropolis, spend the early years of life. The boys of the farm, to-day, are those who will determine whether, in the new era of world-wide influence upon which our nation is entering, she will be true to the principles of fraternity and freedom that have made her great. The ranks of the legislators, judges, diplomats and millionaires are in every generation recruited from the farm. It is through the life blood of honesty, simplicity, frugality and industry, which has flowed from the rural districts in

the past, that the national life has been kept vigorous and pure. Shall it continue to be so in the new and perilous future which is dawning? With you farmers, more than with any other class, rests the answer to that question, and the farmers of this great Empire State have a potential influence in shaping the destiny of America more decisive than those of any other State in the Union. The mortgage on the farm, and the incoming foreign tenant, mark the decadence of the class of citizens who have been the great balance wheel in our social and political life, the independent owners of the soil they till.

"There is a tide in the affairs of men which taken at its flood, leads on to fortune and to fame." The incoming tide of material prosperity is rolling in on us as a people. Let the farmers seize the opportunity it offers. Let the lessons of experience keep them from being swept away in the popular current of extravagance and speculation. Let higher intelligence and enterprise lift the noble calling of husbandry to a level with the learned professions in popular estimation. Let the farm life be made attractive to young men by substituting the lyceum and the literary club, for the nail keg and the three-legged stool in the grocery store. Let the farmer look beyond the boundaries of his own paternal estate and understand that his interests are involved in the general intelligence and enterprise of the community in which he lives. Let him understand that good roads are equally a factor in his success with well-kept stock, or well-ploughed fields. Intelligence, enterprise, public spirit—let these be the watch words of the grange and the characteristics of the church. Then hand in hand and heart to heart they will move forward to shape a destiny for our country which shall make her the renowned of earth and the greatest factor in peopling Heaven.

Sullivan County Farming.

By C. W. Heath.

Every occupation is necessarily subject to certain disadvantages peculiar to its line, varying in proportion to the complete nature of its surroundings; but taking everything into consideration, none are more exempt from these than the class engaged in agricultural pursuits. That this is so, is not at all mysterious when we consider the nature of their calling. Both in winter as well as summer nature is doing for them a work which it can do for no other class of men, and which actually costs them nothing, nothing physically or financially; such as the growth of cereals and other vegetation; while the grass, though withered and decayed upon the surface, is recuperating strength and vigor at the root for the coming spring; and the action of the frost has clarified the soil from impurities and to some extent destroyed innumerable insects detrimental to vegetable growth.

The great difficulty is that farms as a rule are too large, more so than can be profitably handled. If farming on general principles cannot be made successful on 50 acres in a state of good cultivation, it is useless to suppose that any additional number will prove more remunerative. The crops raised would prove to be not only equal in quantity, but far superior in quality, and consequently command a higher market price. As the ruling now is, fully one-third of the land tax is drawn from what is perfectly worthless under its present condition to the owner, hence a burden upon that of a more remunerative nature; thus the occupation, to that extent at least, is rendered unprofitable.

That those engaged in agricultural pursuits possess an average degree of prosperity is plainly manifest when compared with those engaged in mechanical labor of any description. While the

latter, to a great extent, is dependent upon others, is in most cases a tenant at will and is obliged to purchase everything he needs for himself and family, the farmer employs himself at remunerative wages, is in possession of a home for himself and family and produces at least one-half of the necessaries of life.

In everything we undertake to do, in order to be successful, a certain amount of intelligence combined with the necessary capital and labor is always requisite. The merchant in order to do a profitable business must keep constantly on hand such a class of goods that pertain to his line as the wants of the public from time to time require. If he buys unseasonable goods at an unseasonable time they will accumulate on his hands and eventually so depreciate in value that his business will prove a matter of loss rather than gain, if not drive him into bankruptcy. This is equally true of the farmer. He must learn to adapt himself to the conditions by which he is surrounded. While physical exertion is the main factor in successful agricultural pursuits, nevertheless, unless guided by an intelligent knowledge of his calling, a great waste of energy will ensue. If we undertake to fight against nature we will be worsted every time. It is essential that the farmer should know the exact elements which are incorporated in the soil he undertakes to cultivate, to the end that he may adapt his crops to it; and should they be of such a nature that he does not desire to raise them, he must manipulate the soil to bring it into a condition adapted to raise the ones most desirable. When the hand and the brain work in unison together the highest type of successful farm labor is reached, and under no other conditions.

At a recent farmers' meeting the question was asked: "Why are not farmers more prosperous?" The consensus of opinion of those present appeared to be that their calling would not permit of their accumulating wealth as fast as business men do, nor as fast as their labor entitled them to, that their reward was not proportionate to their labor. While this is undoubtedly true, it is an erroneous idea to suppose that true prosperity consists altogether in the accumulation of wealth when, all things con-

sidered, it is only a secondary consideration, but consists chiefly in contentment and accompanying happiness, the offspring of a legitimate calling faithfully followed.

The naturally poorest land when in its virgin state is always good for a while, but must eventually succumb to over-cropping, unless liberally rewarded by stimulants in return for the tax imposed upon it. How far this can be done, is a question entirely dependent upon the amount of capital the owner is able to invest in that direction, and must be left with him to determine.

It seems to be the general opinion of those who have tested it that small fruit culture may be very profitably engaged in by anyone having the requisite quantity of land under a good state of cultivation. When once properly started, small fruits do not require any extraordinary amount of labor to keep them in a proper state of cultivation. Strawberries, although a delicious fruit and always saleable in season, require too much attention to make them profitable, unless they can be put in the market very early in the season, which cannot be successfully done in our latitude. The most reliable and best payers are raspberries, currants, blackberries and gooseberries. The last two require the least attention annually to secure a crop. So far these two have received but little attention in this section, but as their nutritive qualities are becoming better understood, they are fast coming into public favor.

Darwin, in his theory of environment and evolution, tells us that the fittest always survives. I accept no such view, for I have in my own limited sphere observed facts which contradict such an assertion. If he had said the *strongest*, he would, in most instances, have come nearer the truth. This is observable in the animal kingdom, the more powerful and ferocious preying on the more docile and domestic species.

Turning our eyes to the vegetable kingdom, we are met with the same condition of things, with but this difference—if we would preserve the fittest, that is the most essential—we must assist nature in developing her resources, promote their growth. Unquestionably all the varied and beautiful flowers which adorn

our gardens, lawns and houses, whether of home-culture or the product of foreign soil, originally existed in a wild state, as evidenced by the fact that many of them are to be found in their primitive condition, where the foot of man had heretofore never trod. The fragrant violet, the beautiful daisy, the brilliant rhododendron, and the pale tinged lily, of whom it is said that Solomon, in all his glory, was not arrayed like unto one of these, which existed in years long gone by, would blush in the presence of its offspring of to-day.

It is a highly commendable feature of our day that in the construction of most of our modern houses, provision is being made for the culture of native and foreign flowers. They not only afford a continuous scene of delight to the propagator, but in many instances, are quite remunerative in their nature, as year by year they are becoming more popular with our people, an evidence that we are becoming more refined in our tastes. They cost but little, and everyone should cultivate them to the extent of their ability.

While it is true that farm produce is very low, it is equally true that all other productions are in line with it; so that while the farmer sells low he buys on the same basis; therefore, it is evident there is no discrimination in favor of one class more than another in the world's market. We may increase the amount of production, but we cannot increase the demand for its consumption; that is dependent upon the money market, the call for labor and the state of trade generally, both at home and abroad. When prices are good the farmer and the manufacturer are equally benefited. When prices range high the farmer receives as much in proportion for his produce as the merchant or manufacturer is enabled to realize in their respective departments, and thus things become evenly balanced, or as nearly so as it is possible to make them. In agriculture and manufactures there is no normal condition, for they never acquire a normal state and never will. Fluctuation is the natural outgrowth of increased and diminished demand and can never be regulated by any other standard known in commercial circles.

As regards the price of farm labor, which always pays better when employed on good than poor land, it certainly is as reasonable as that of any other employment, and if, as in a majority of cases, it is too high to prove remunerative to the employer, it certainly is not the laborer's fault, for no one can decently support himself and family on less than the present ruling prices. If the farm is clear of all indebtedness and in fair condition, no doubt it will pay to hire help. No rule can be laid down to govern its advisability in all cases; everyone must be his own judge.

Through fear of doing too much for posterity we often cheat ourselves, or, in other words, do not advance our own interests as we should for fear that others, some time or other, may enter into our labors. This, to say the least, is taking an extremely selffish view of the matter, and had our forefathers been actuated by the same principle we should not to-day be enjoying the advantages we have derived from their labors. We cannot isolate ourselves from each other and enjoy the benefits which accrue from a union of labor. Notably is this the case in the setting out of fruit and shade trees. We not infrequently allow ourselves to be reasoned into the belief that we will never live to reap the benefit of our labor and expense, and that it is unnecessary to do for posterity what they in after years can do for themselves, and thus the duty is allowed to go by. The fact is, however, that we reason falsely. In most cases the subject comes up for consideration in youth or middle age, and if acted upon we may and do in most instances live to see them come to maturity. Even if advanced in years we should by that time have learned a lesson which searches out beyond self. Twelve years, under favorable conditions, will bring an orchard into good bearing condition, and twenty years, at the outside, will produce maple trees large enough annually to tap, and at the same time afford a most luxuriant shade. The state has wisely recognized this fact in the matter of shade trees, and offers every necessary inducement to farmers and others to set them out along our highways. They are at once a thing of beauty and of profit, and the sooner we

realize this two-fold benefit, the more anxious will we be to do our share in this commendable work. It is gratifying, however, to observe that the practice is yearly becoming more adopted, and ere long will become general throughout the state.

The relative position of capital and labor is one in which those engaged in agricultural pursuits are deeply interested, for they are the main factors in the latter, the producers of the former. Labor is capital, but capital is not labor; it is only the product of the former and can never take its place. The coffers of a people might be full to overflowing and yet they starve for the want of the necessaries of life unless a large percentage of its population were engaged in their production. No amount of wealth would ever construct our public works or private residences, if labor was not brought into requisition. When it ceases, capital loses its prestige and fails to benefit the world. Without labor the merchant might stand behind his counter until his goods rotted on the shelf, and he became a fair specimen of an Egyptian mummy, were it not being utilized to supply the means to purchase the necessaries of life.

We are in the habit of speaking of material waste, particularly as it affects the farmer in pursuing his avocation. Whatever has existed since the dawn of creation exists to-day, though in a measure in a modified condition. There may be, and undoubtedly is, under certain conditions, much individual waste to be guarded against; but there can be no general wastage—what one loses another gains—it is reactive and beyond control. The so-called waste, attributed to the negligence of our forefathers, is now productive of some of our most fertile islands and bottom lands from which we reap a rich reward; while those who come after us will experience the same results by what apparently is our loss. If we are not too liberal in our gifts to nature no harm will eventuate. When the bed of the ocean, lake or river becomes super-charged with debris from the land, it possesses the power of throwing off this surplus of extraneous matter. Thus the benefits of a munificent Creator are equalized and eventually assume a normal condition. The word annihilation, from which

has sprung the idea alluded to, should be blotted out from our vocabulary, for it has no meaning. I do not know how it got there or why it remains there, unless it is a device of the devil to lead us astray, as it certainly does. God never created anything that diminishes in bulk or deteriorates in value and ever serves a wise and beneficent purpose, whether we realize it or not. He who, metaphorically speaking, holds the waters of the great deep in the hollow of His hand and has numbered the sands upon its shore, will never allow one drop of the former to evaporate or one of the latter to decrease in number, and when we shall cease to march with the tramp of time and one by one fall out of line, our bodies will be utilized for some good purpose.

Good cheer and mutual sympathy should prevail in the home of every family, for the inner life devoid of these essentials to true happiness is no shelter from a tempestuous world of disappointment and trial. The home of the farmer, more than any other, can be made to partake of these elements, and if they had been fostered to the extent permissible under the circumstances, I surmise that families would have been more united in their efforts to retain the homes of their fathers. But gradually a distaste for their avocation has manifested itself among some of their descendants who have sought the first opportunity to free themselves from it, and thus deprived of the services of those who are, or should be, interested in maintaining the home, parents are left alone in their declining years to fight life's battle alone; or, if help must be had, to seek it outside of the family. It is wisdom to retain the farm as long as practicable and as much as possible the children upon them, and thus hand them down from generation to generation to the end that they may be happy and prosperous by being engaged in the noblest of all occupations—that of tilling the soil.

Better than a marble shaft to perpetuate our memory is a busy and useful life, where creations link the past with the future, for he who by untiring industry helps to feed and clothe his fellowman is doing more to lay deep and broad the foundation for com-

ing generations than the king upon his throne or the ruler of a nation. Although we may not be able to leave an impression upon the field of science, literature or art, we may upon the soil, the more lasting of all, for nature is never forgetful of her patrons.

The influence of farmers' institutes, now so successfully organized throughout the State, is manifest in every direction in which the farmer is interested. New methods of culture have been very generally adopted by those possessing the means to introduce them; while many improvements of a general nature, suggested by the experience of those who have tested their convenience and utility, have taken place in the home and out-buildings of not only the agricultural but other classes of citizens. Farmers should take advantage of these opportunities so generously afforded them by the State. Those who conduct these institutes are all men of superior intelligence in their respective line of thought, and merit the confidence of those who are privileged to listen to their instructive addresses.

The year 1899 was a more than usually prosperous one for those engaged in agriculture. Cereals of all kinds, except buckwheat, were more than an average crop; potatoes, planted on high ground, were an unusually good yield, while those raised on low land rotted to some extent. The apple crop in this section was large, but not of as fine quality as that of most preceding years. The crop of small fruits was large and of good quality, and met with a home market at remunerative prices. Indeed, there is more profit derived from this source than that of any other, when the labor expended in their production is properly estimated. The present season will be productive of a still larger crop, as many others not heretofore engaged in the business are turning their attention in that direction. The grass crop was fairly good, and the open weather experienced late in the fall has left quite a surplus on hand to add to the coming harvest.

The twenty-fourth annual agricultural fair was held at Monticello, August 29, 30, 31 and September 1, 1899. The number of exhibitors was 140, and entries as follow: Horses, 77; cattle,

212; sheep, 31; swine, 25; poultry, 347; vegetables, 326; potatoes, 403; grain and seeds, 154; dairy and culinary, 139; fruit, 227; flowers, 138; implements, etc., 11—total, 2,090.

Ladies' department: Domestic, 103; fancy, 232; art, 61; children's, 18; discretionary, 83—2,079.

At a meeting of the society, held December 21, 1899, the old officers were re-elected as follow: President, P. R. Polton, Avon; vice-president, W. J. Kinne, Maplewood; secretary, Roscoe Decker, Monticello; treasurer, S. L. Strong, Monticello. E. L. Sleath and M. C. Stewart were elected directors for three years, and George Knoll for two years. P. R. Pelton is corresponding secretary.

On the 12th of December, 1899, the twenty-fifth anniversary of the "Old Farmers' Club" was celebrated at the residence of Irwin Mapes, in Monticello. It originally consisted of forty-four members, twenty-one of whom have subsequently died. On this occasion John D. Buchanan of Liberty Falls, gave a brief history of its organization, growth and ultimate consolidation with the agricultural society as it now exists.

The town of Thompson has a Farm, Garden and Fruit Club, which meets every two weeks at the home of one of its members. Every branch pertaining to farming is here discussed and new methods brought to notice. But the most interesting and profitable feature of these gatherings is derived from the question box. It brings to notice many things which of themselves are generally considered of minor importance, but in the aggregate form a constituent part in farm labor. These clubs should be more general throughout the State than they are, and undoubtedly will become so when their value is better understood.

The following are the officers-elect: President, Leon Stratton; vice-president, Mrs. George Conrad; secretary, B. M. Lindsley; treasurer, Mrs. R. H. Hall.

A club was organized in the town of Liberty in 1872, with B. W. Gregory as president; F. P. Currier, vice-president, and M. B. Hall, secretary. In 1891 it was reorganized as now existing, with B. W. Gregory as president; W. H. Nichols, vice-president; J. O

Newkirk, secretary; John Chaffee, treasurer. The by-laws of the club limit the membership to twenty members and their families (private families, as a rule, not being able to accommodate more), and meets monthly, except in July and August, at the home of one of its members. The discussions include agriculture, horticulture and floriculture. Music is rendered and refreshments served.

The Irrigation Schemes of the West.

By GILBERT M. TUCKER, Editor of the Country Gentleman, read before the New York State Farmers' Congress at Albany, N. Y.

When a dog is about to lie for a nap, you will notice that he is very apt first to go through a perfectly useless and seemingly unmeaning performance hardly in character with his wonderful sagacity which so closely approximates the intelligence of man. He turns round and round two or three times in a little circle, his head about touching his tail. Why does he do it? Simply because his savage ancestors, thousands of years ago, living in forests undergrown with brush and weeds, noticed that they were more comfortable in their hours of repose if they first constructed in this manner a rough nest or bed. The turning round was to level the plant growth and smooth it down into a sort of mattress. What was at first a perfectly reasonable and commendable procedure, taken under the guidance of something very closely resembling intelligent thought, came in time to be instinctive—that is to say, it was and is performed under an unthinking impulse; and the instinct became ultimately so fixed in the race, so runs in the doggish blood, one may say, that it dominates the actions of the remote descendants of those early canine creatures to-day. The dog continues to perform, without necessity, sense or purpose, on a soft carpet or a smooth wooden floor, the operation which his far away ancestors performed, with very good reason, in the rank undergrowth of their native forests. The practice goes right on, centuries after changing circumstances have utterly destroyed its original value.

Similar occurrences of the persistence of superannuated practices are very frequent through the whole domain of animal life; and man is not exempt. Many ideas and beliefs, once sound, con-

tinue to influence human life long after they have entirely lost all application and fitness to a later environment, and have therefore become at least useless, in many cases positively detrimental to prosperity. Such ideas and beliefs, inherited from past generations and still cherished, without reflection or consideration of altered circumstances, dictate to a lamentable extent the policy that governs in our time the management of the public domain, still the property of the people.

Time was, say a couple of centuries ago, or even not quite so far back as that, if you like, when every foot of extension of the civilized occupation of this country back into the wild interior, every increase in population not positively vicious, was in many ways a real and solid gain to the people of the American provinces. Occupying as our forefathers did but a narrow strip of land along the Atlantic coast, with only inchoate manufactures, very slow and uncertain communication between different sections, and agriculture not much more than adequate to provide for very modest living, the one thing that was wanted before all others was development of the nation. The father of a large family of stalwart sons and daughters was most distinctly a public benefactor. As the children moved westward, bringing into cultivation acre after acre of new soil, and thus supplying better and better the needs of a growing population and enlarging the material resources of the common stock, they were laying broad and deep the foundations of the future greatness of the nation, and every pioneer deserved a godspeed from all well wishers for mankind. If any central authority had at that period exercised effective control over the unoccupied lands that stretched off, seemingly without limit, to the west, it could not possibly have done a better thing for all concerned than to facilitate by every means within its power the taking up of these lands as fast as possible by anybody who could be induced to occupy and cultivate them. Pioneering and homesteading were philanthropic occupations of the very first order of necessity and merit.

But it must never be forgotten that the circumstances of the seventeenth century in this country were radically different from

those that surround us at the dawn of the twentieth; and that many lines of public policy once eminently laudable have become obnoxious and dangerous as times change. When a baby weighs ten pounds, it has just one alternative before it—grow, or die; when in after years the ten pounds has become two hundred, the condition of affairs is changed; further increase is suggestive rather of dropsy than of growth. The behavior most suitable to the infant nation, just stretching its unformed limbs and not yet quite certain what sort of creature it will grow to be, becomes in the highest degree absurd and detrimental when maturity has been attained, and the former infant has reached the understanding and the enjoyment of the powers of manhood. Of this obvious fact, in its relation to a rational management of the public domain, sight has largely and most unfortunately been lost by the American people. We go on hurrahing for every increase that successive censuses show in our population, with very little consideration of the quality of the people that have been added—in our agricultural area, with very little consideration of its actual value to the nation—and above all, in our production of crops, without any consideration at all of the profit of growing them or the real financial condition of the men who are feeding half the world. We go on turning round and round like the dog, merely because our ancestors did so and we take it for granted that that must be the proper thing. To sum it all up in a nutshell: Time was when every enlargement of our agricultural area conduced to the general welfare; such enlargement does not conduce to the general welfare now—quite the reverse. All the same, we go on tranquilly permitting if not actively encouraging such enlargement, and felicitating ourselves on that which is really, though insidiously, bringing upon us a train of appalling evils.

Before endeavoring to indicate definitely what some of these evils are, and the ponderousness of the weight that they are throwing upon our financial prosperity, let me make a plain statement of the speed and energy with which the government is dissipating and worse than dissipating our priceless heritage of culti-

rable lands, the property of the nation at large, and transforming what ought to be a blessing into a veritable curse.

According to the reports of the General Land Office down to July 1, 1899, the latest available, the average rate of alienation of our public lands for the decade last preceding that date was nearly 11,500,000 acres per annum, which is approximately 1,000,000 acres per month, over 31,000 acres per day, about 1,300 acres per hour, more than 21 acres per minute, or say one acre every three seconds, day and night, Sundays and holidays all included. Let us try to picture to ourselves what these figures mean. They mean that more than 17,000 square miles, an area considerably larger than one-third of the State of New York, is given away, practically given away, every year of our lives; nearly 1,500 square miles, considerably more than the State of Rhode Island, every month that passes; more than two square miles every hour. Imagine yourselves standing at the boundary, if there were such a boundary, between the land now the property of individuals and that which still belongs to the nation at large, and seeing that boundary moving before your eyes into the government possessions at such a rate of speed that the latter were steadily shrinking, hour after hour, day after day, year after year, at the rate of 21 acres per minute! Such is the rapidity with which we are energetically squandering our most inestimable possession. Our property burns our pocket, as they say of a spendthrift's money, and it seems that we shall never rest easy until we have dissipated the whole.

Now, of course, you will say at once: "Well, well, but we are not giving the land away; the national treasury gets something for it; and besides, we are developing the country. What in the name of common sense is land good for, arable land, if not for civilized man to cultivate? We are giving homes to the homeless of all the world. There is no grander chapter in the history of mankind than the filling up of our great western territory with industrious, intelligent, free and happy people."

Let us consider these points.

The return that the government receives from the average of all its agricultural land parted with, year after year, comes to so little more than enough to pay for the actual expenses of marketing it, that this return may be left out of the question. And then, it must be borne in mind that with the rapid increase of population in this and other countries and the consequent constant increase in the demand for food, it is perfectly certain that these wild lands of ours will be worth very much more, will actually command a much higher value in cash, if held and sold only on business principles, during the time of each successive generation than during the time of that which last preceded it. We are forcing upon a market already fearfully oversupplied the property for which the future is positively certain to bring a vastly increased demand at vastly higher prices than can now be secured for it. For all practical purposes, the lands are given away.

But we are furnishing homes to the homeless, and developing the country! A great many birds have been caught with that chaff. A farm is primarily a factory, only incidentally—and accidentally—a home; keep that distinction very clearly and sharply in mind, I pray you. Of course the owner may live on the premises; so may the owner of a cotton mill. But in every respect in which the occupancy of new farms at the far west affects the interests of the present owners of the property out of which they are carved, the people of the United States, each new farm is to be considered entirely as a new factory, entering directly into competition with those now established.

And as to developing the country: The long life of the passion for accomplishing that very indefinite feat is a straight case of the dog's turning round before he lies down because his ancestors discovered that the practice, under the circumstances then surrounding them, conduced to their well being. A century ago, no doubt, the country needed development; but, great heavens! what is the haste to develop it further just now? Are we not numerous enough, strong enough, as a people? Could any nation on earth dream of invading our territory? What in the world are

we gaining, what can we possibly gain, by this frantic, breathless haste to develop, to fill up our whole country with people, any and every kind of people, foreigners very largely, the offscourings of the earth in no small part? Whoever has leaned on the forward rail of a westbound Atlantic steamer and watched for a while the immigrants on the steerage deck below, as I have done many times, must pray earnestly for the day when America shall most definitely go out of the business of offering an asylum to the downtrodden of every clime. What does it profit us? For my own part, I think the development, the filling up, is going on far too rapidly to be a healthy process; and I am very sure that the not inconsiderable fraction that comes to us yearly from abroad is something that we could very, very well manage to dispense with.

And now for what is after all the one main point of practical interest. How are we injured—we, the farmers of the Eastern States, and the classes that depend directly upon the farmers of the Eastern States for prosperity—in what way, definitely and exactly, are we injured by the liberality of the government in giving away its wild lands, our wild lands, as fast as possible, to anybody and everybody that will take them?

In the first place, of course one thinks naturally of the competition of the products of the new farms, in the markets of the world. I am inclined myself to the opinion that the injury in this direction is rather less than might be supposed, and that it is in fact very far from being the darkest element of the problem. The growth of population must of itself take care of the increased production, in part. The new farmers need an infinity of things that they cannot possibly produce. That helps manufactures; manufactures require workmen; workmen must eat; and thus the established farmers of the older regions will find a certain increase in the demand for their products, making up, *in part*, for the new supply thrown upon the market by their increasing competitors. And then again, the price of breadstuffs is very largely governed by the yield of crops abroad and the occurrences of every kind that take place in foreign countries. Wheat *may* bring a high price, though the American crop be immense; it *may* go begging, though our fields yield the scantiest return. Still, of course, it is

patent that on the whole every new State in an agricultural region will for a long time export a considerable surplus of foodstuffs of some sort, and thus act distinctly, to a certain extent, in bearing down the market price. Most assuredly, after making all allowances, the competition of the new regions in selling just what we want to sell, is a danger and an injury that must be taken into the account. But that is only the beginning.

A second channel of mischief is the absorption by the free lands of the men and women who ought to supply, and in the normal condition of things would supply, an abundance of labor, at moderate wages, for established farmers. The demand for trustworthy farm help, at prices that farmers can afford to pay, is left largely unsatisfied—to the injury of the farming interest, and perhaps most of all to the overburdening of the wife of the small farmer with tasks of which hired servants should greatly relieve her—by the facility with which the persons who ought to supply it can go west and become farmers on their own account, your property and mine being freely offered them for that purpose. Why should anybody work for you, except perhaps at extravagant compensation, when the government is willing and anxious to make him a landed proprietor himself, without money and without price?

Nor is it farm *labor* alone that is drawn away from its natural homes by the recklessness of Uncle Sam in giving everybody a farm. A class of people better off financially go west also and take their money with them, the class among whom the farmer looks for tenants if he wishes to let his property, for purchasers if he wishes to sell. Why should a man of some means hire your farm or buy it, if he can get one of his own for nothing, grow up with the country, and presently land in Congress and go to making laws for you and the rest of us?

Now notice, please, how these three wrongs converge to drain the very lifeblood of the established farmer who has bought his farm and paid for it, or (still worse) owes something on it. The value of his crops is reduced by unfair and illegitimate competition; the supply of labor that he needs is minimized and therefore its price enhanced; and the class among whom he ought to be able to find tenants or purchasers is immensely restricted. The same malign influences act, of course, on all his brother farmers. Their

profits, like his, are immensely diminished, and many of them, like him, are offering their farms to anybody who will pay a good rent or buy at a reasonable value. Thus an unnatural and intensely pernicious competition is set up—set up by our own government, mind you, for which we pay—between farmers of the older States, for the disposal of their property. So, of course, the value shrinks; the farmer falls out of the rank in the social scale that he ought to hold, because his property has so little money value; for, say what you will, a man's standing in society is regulated very largely by his supposed financial means. And if he wants to borrow money on his farm, he finds not only that it will be valued far below what would be normally a reasonable sum, but also that lenders are rather loth to advance money on farm security at all, because the sale of such property is slow and uncertain.

It is maddening to think of. The American farmer ought to be the most independent being on earth, and one of the most envied. Of all property in this country, a farm ought to be the most desired and the quickest in demand. There should be a dozen would-be purchasers or tenants bidding against each other for every farm that there is supposed to be a chance to get. Farm mortgages should be the most sought for of all investments, and the interest should be reduced, by competition of lenders, to about half of what now has to be paid, while the amount that can easily be borrowed should be about twice what it is now. It is all very well to blame the farmers of the older States for bad management when they fail to make money, and hoot at the idea that "farming don't pay." The marvel is that it pays as well as it does; the glory of the eastern farmer is that he can make headway at all, with this horrible burden on his back.

Now consider the equities of the case. This is no sort of a sectional plea, no setting up of one part of the country or one class of our people as entitled to any kind of special favor from the government or special protection from competition. Not a bit of it; nothing like it. The simple fact is just this: The public lands belong to the people at large, and it is distinctly opposed to the interest of the people at large that any more of them should be brought into cultivation, because our great basal industry, the industry on which all other American industries depend, is agricul-

ture, and agriculture is depressed, its profits reduced, by every increase of our cultivated area.

Finally, what is to be done about it? It is too late now to hope for repeal of the homestead laws and similar out-of-date legislation in time to do much good. Ten years ago next October, when the journal with which I have the honor of being connected began the first regular attack that has ever been made on our outgrown and now suicidal national policy of dealing with the public domain, a very large area of arable land was still the property of the nation, and the work of giving it away, to the unspeakable injury of the owners, might well have been arrested. But I am sorry to say that it was then, as it very largely still is, quite impossible to rouse the class most directly interested, the farmers of the older States, to any sort of energetic action for the protection of their own well-being. Farmers' organizations, as a rule, have devoted themselves to all sorts of rainbow chasing, or have frittered away their energies on matters deserving enough, perhaps, but of very trifling consequence in comparison with the immense importance of attacking the one great evil. Very few individual farmers could be induced to call up the matter in granges or similar bodies, or even to interview their own representatives in Congress and urge them to action. Considerably more than a hundred millions of acres—just think of it, a hundred millions of acres—have been given away since then, with hardly an audible protest from the class who were daily robbed and impoverished by the operation, until now it is almost within bounds to say that there hardly remains a desirable homestead in any State washed by the Mississippi or its affluents; and they are scarce anywhere. As the last Year Book of the Department of Agriculture says, "all the best parts of the public domain have been appropriated, and comparatively very little good agricultural land remains open to settlement." One might think we were within sight of the beginning of the end of the mischief, and might hope now for a slow improvement, the supply of wild land being nearly exhausted, while our population is increasing by leaps and bounds.

Lay not that flattering unction to your soul. We are merely entering upon a second stage in the work of spoliation. Animated by an intensely selfish and narrow desire for the so-called devel-

opment of their own States and Territories at the expense of the great body of the nation, the people of the far west are raising in increasing volume, year by year, a demand for the irrigation of the immense area of arid lands now the property of the United States, that at least a hundred million acres more may be brought into the market to compete with your property and postpone to the indefinite future the time when the possessor of a good farm shall be, as he ought to be, an object of general envy. The demand for this outrageous robbery of the people takes two forms. The plot at first was to induce Congress to irrigate this vast area at the national expense—at your cost and mine—that it might be rendered attractive to new competitors in our own industry and divided among them. This scheme of open robbery, however, was a little too barefaced to be very dangerous. Nobody could help seeing that it was just like asking Congress to build factories and give them to any impecunious but enterprising applicant that came along—imagine what our manufacturers now in business would say to that! This plan therefore is not, just at present, pressed very actively, though still rearing its horrid front, in some form, during every session.

But another scheme has been devised, to which it is hoped there will be less objection. It is simply for the national government to give, give out and out, all our arid lands to the States and Territories in which they happen to lie, in order that the local authorities may do the irrigating themselves. Just think of it. These lands are the property of all the people, just as much the property of the farmer in the northeast corner of Maine or at the extremity of the Florida peninsula, as of the people who live around them; five-sixths of all our population are east of the Mississippi and Missouri; and yet it is seriously proposed—yes, vehemently urged—that their ownership in the lands referred to be taken from them by force and given to the handful of people in the newer regions, these people themselves being chiefly the beneficiaries of the previous injustice of the government under that miserable old homestead law, that the property may be used directly and actively to the injury of the present owners. It is difficult to speak with patience of a proposed iniquity like that. If some of our Montana friends who are doing their best to bring it about were owners of valuable lots in Boston, which they pre-

ferred to keep vacant until a growing demand should bring an increase in their selling value, and the Bostonians living round these lots should endeavor to seize them, under color of developing Boston and providing homes for the homeless, one can imagine the indignation of the owners and the opinion they would express of the conscienceless rapacity of the plotters. The shoe is on the other foot; it is not their ox that is gored; and the plotting and scheming goes bravely on.

This brings us directly to the answer to the question—no matter about the past; what is now to be done? Just exactly this. Let every man of you resolve to exert himself in all proper ways (and there are many) to kill every bill that comes before this present session of Congress and every future session for the irrigation under any pretense of the arid lands, or for the giving of them away to the States in which they lie. You can accomplish infinitely more than you perhaps suppose, if you will use your power. The editorial pages of the *Country Gentleman* will keep you constantly informed of every one of these miserable bills as it comes up, giving definitely the number on the calendar, the name of the introducer, and the committee to which it is referred. Let every man who hears me sit down then, immediately, and write a personal letter to his Senators or to his Representative, according as the bill makes its appearance in the Senate or in the House, and also to the chairman of the committee having it under consideration, invoking his active opposition. Let him ask all his neighbors to do the same. Let him see that his grange, or any sort of agricultural union with which he may be affiliated, adopts ringing resolutions of protest, and that the secretary sends copies to the Representative and the Senators. God helps those who help themselves. If the farmers of the East permit the far-western schemers to pursue their course of determined spoliation, enriching themselves, indirectly perhaps, but not the less really, at your expense and mine, the farmers of the East must expect conditions increasingly unfavorable, year after year, decade after decade, for themselves and for their children; must expect that increasingly severe and unintermitted toil will yield increasingly meagre returns; and must expect themselves to descend gradually but steadily in the social scale till there shall be none so poor to do them reverence. In time, no doubt, a century or two perhaps,

conditions must change again, as our increasing population makes larger and larger demands for food, while the supply of land on which it can be raised becomes proportionally smaller. But there is no earthly need to postpone the beginning of this recovery to an indefinite epoch in the uncertain future. Let the farmers of the East put forth but a mere fraction of the power which they most properly hold, if they would only use it, over our national legislation, to stop this tremendous and tremendously cruel and unjust competition by the beneficiaries of our own government, and especially to strike at this hydra of an irrigation scheme in all its phases whenever it appears, and the possible prosperity of the vague future may be realized within our own time, in a solid financial return for that form of labor which most deserves the triple boon of a bright and hopeful youth, a contented mind at maturity, and a competence with honor in declining years. Not, of course, that any legislation, or the absence of any legislation, can of itself make all farmers prosperous, any more than any legislation, or the absence of any legislation, can of itself make all men honest and prevent cheating. But although legislation is often impotent for good, it is always, if unwise or unjust, almost omnipotent for evil; and at the present time unwise and unjust legislation creates the one only cloud in the otherwise bright sky of American husbandry. To prevent the enactment of unwise and unjust laws, having for their sole purpose the enrichment of a comparatively restricted section of the country at the expense of all the rest—this is the one paramount duty of the hour.

The Man With the Hoe.

James Hilton, New Scotland, N. Y.

Thirty-five years ago a French painter living in the little village of Barbizon, near Paris, painted a small picture of a weary peasant man, with bent back, heavy, hopeless face and work-worn hands resting upon his hoe. This canvas, together with "The Angelus"—probably the best-known work of this artist in America—was hawked about Paris and finally sold to a small tradesman for an insignificant sum. After the death of Jean Francois Millet, France awakened to the fact that he had been the truest delineator of peasant life the world had ever known. His pictures were sold and resold for fabulous sums, and after many years the "Man with the Hoe" crossed the ocean to America, the property of a wealthy Californian—(Mr. Crocker)—who paid for it $60,000. People who saw the little picture, dimly felt its pathos, but it remained for an American gentleman—Prof. Edwin Markham—to interpret the picture in a great poem, which will live as long as literature endures. He has himself told us that when he first saw the "Man with the Hoe" at a loan exhibition in San Francisco, he stood before it an hour, absorbed and enthralled by the sight of this sad shape, which to him seemed not to portray a chance peasant, a mere man of the fields, a figure Millet had chosen to paint simply because of its artistic possibilities, but to express betrayed humanity—the Toiler, ground down to the level of the brute through ages of oppression and social injustice. He saw in it the working man pushed to the wall by monopoly and greed, until he had become a mere serf, with no mind in his muscles and no heart in his handiwork. He saw in it the slow, sure, awful degredation of man, through endless, hopeless, joyless labor. This pathetic figure seemed to him the very type of industrial oppression; a being with no outlet to his life,

and no uplift. As he gazed, his heart thrilled with pity and terror over this pitiful example of humanity that had fallen down, and he resolved then and there to speak a word for the humbled, the burdened, the silenced of earth. You who are familiar with the poem know with what power he fulfilled his purpose. It is a terrible arraignment of the men who are the "masters, lords and rulers" of the world, who have failed to be fair to their brother of the furrow.

Millet, who stamped his genius on the little canvas, was of peasant parentage, having worked with his father in the fields of France until he was 18. No one knew better than he the human ruin which may be wrought by years of overwork and under pay.

Markham, the poet, was a working man also—a "hoe man" indeed—all through his boyhood and early manhood. He tells us that "the smack of the soil and whirr of the forge" are in his blood.

His poem is not a protest against labor, but the degradation of labor, the terrible oppression of man by man. The author believes, as every sensible person must, that labor is a humanizing and regenerating power when wisely directed, and entered upon with zeal and enthusiasm. But he knows, also, that work may be so hard and the burdens so heavy as to deform the body and starve the mind. The constant companionship of poverty and fear saps the energies and destroys the power which makes us men.

Probably no poem in the last half century has so deeply stirred the hearts of thoughtful people as the one under discussion. Praise and criticism have been lavished upon it indiscriminately. Some superficial thinkers among our agricultural brethren have resented certain passages in the poem, and have rushed into print to tell the public they were neither "brother to the ox" or "slave of the wheel of labor!" This clearly proves that they have failed to grasp the deep meaning, the great purpose of this modern example of "holy writ." To me it is a clarion cry for justice! A mighty plea for the socially submerged, for the unfortunate many who are ground and bruised and broken on the wheel of life, that the few may have more than they need of food and shelter and life and light.

Critics have insisted that we have no peasant class in our young, rich, independent America; that the principles of our government and the spirit of our institutions forbid that we ever shall have. While disposed to accept the optimistic view of this question, I must, nevertheless, call attention to the fact that America has imported plenty of stock from which such a class may breed. A tour through the West will show that our prairies are already thoroughly planted with the seed of a European peasantry. Freedom and liberal education must be depended upon to leaven this lump. It would indeed be difficult to believe that our American farmer or farm laborer could ever degenerate into the poor creature of the picture and the poem. For myself, I regard life on a well-conditioned farm a wholesome discipline for mind and body. I do not believe it is generally felt to be a hardship even from the view-point of the "hired man." In New York State he certainly receives a fair share of the profits of the farm, and has none of the responsibility of management. The farmer has his troubles and grievances, but if called upon to name the class most deserving of pity, I would not look for it in the fields of agriculture, but turn to our brother of the mines—that underground world where human lives are worn away in brute ignorance of all that makes the glory and sweetness of life! Human beings living like the denizens of an ant-hill, without the ant's share in the benefits of his labor!

The French peasantry which the Barbizon painter portrayed so well, is not a recent growth, but the product of powerful causes and conditions, whch have been operating in France for more than two centuries. Demolius, the French sociological writer, tells us that the chief cause of the demoralization of agriculture in France is due to the desertion of this profession by large land-owners, and the abandonment of country for town life. There is no country in the world where agriculture is so forsaken and discredited as it is in France. This result may be looked for in any country where the people become estranged from rural life and regard living on a farm as the gloomiest exile. No one can doubt that the profession of agriculture is important and necessary to a successful social system. It should and must, therefore, demand skill and intelligence in its followers if we would save it from the demoralization and decay which is apparent in France.

The so-called commonest professions in our system—agriculture, industry and commerce—represent the most vital and essential part, because through these are procured the daily bread, upon which all other work depends. If these professions are made to suffer, the whole social body must suffer; if they decay, the social body must decay, as surely as the physical body decays if not properly nourished. If necessary we could probably live without lawyers, without journalists, without officials, even without physicians, but we could not live long without the farmers, who provide the food, nor without the manufacturers, who furnish the objects and implements of essential use; nor without the traders, who distribute indispensable goods to the places where the demand exists. It is good for us to realize sometimes that we are quite as important to the world as the world is to us. Agriculture is the most stable of all professions. It is not subject to sudden changes like industry and commerce. It presents a regular routine from sunrise to sunset. A farmer who permitted his cows to go unmilked would court disaster as surely as a manufacturer who would allow the machinery in his mills to run without attention or service. The man with the milk pail may not go down to posterity in a great picture, but he has his uses.

Some farmers have a great fear of competition. The very word somehow seems to express hard conditions—especially when it happens to affect us personally. Nevertheless, competition brings about some good results. It compels people to greater industry. It keeps things moving. Some one has said that man is as lazy as he dares to be, and one of the early fathers thought that laziness must be the "original sin," it is so common. Prof. Henderson says: "The tendency of competition is to starve out the feeble, the slow, the indolent, and to give the world and its soil to the healthy, the vigorous, the cunning, the inventive." If this be true, competition and kindred evils will eventually create a "Man with the Hoe" class in America. A system which serves to "starve out" any of our people should be abandoned. The altruistic plan is better; help the feeble, encourage the slow and indolent, rather than trample them in the dust to perish, as the race moves on to finer achievements.

The endowment of faculties is so unequal that the fortunes of men must be unequal also. Abraham Lincoln stated this princi-

ple very clearly when he said, "Property is desirable, is a positive good in the world. That some should be rich shows that others may become rich, and hence is just encouragement to industry and enterprise." It is the criminal misuse of wealth which irritates the public mind, yet there never was a time in the history of the world when the possessors of great wealth were doing so much for society and for the poor. Men are coming more and more to comprehend that their fortunes are held in trust; that wealth has been given them for the divine purpose of helping and making better the world in which we all must live. There is danger and menace in idleness, whether forced or voluntary.

It is natural for healthy men to like work, bodily exertion, strenuous struggle. Our college-bred young men must row a boat, play baseball or kick a football. If our field work could be done with the same spirit of zest and good cheer, it would go far to solve the labor problem for the farmer. Once there was a wise father who induced his young son to cut down a whole field of mullein and other noxious weeds by telling him they were hostile Indians to be exterminated. Imagination is a very good thing to cultivate—in moderation.

Industrial prosperity will not be permanently established until the wages, profits and perquisites of the agriculturist are large enough to tempt men voluntarily to adopt that profession; until the State and government shall reduce to a minimum its own prerogatives, thereby attracting young men to independent callings which demand individual effort and personal exertion; in brief, not until we have a social state in which the politician and the idle man shall receive less consideration than the farmer, the manufacturer and the trader.

It would be a great help to American agriculture if we could make rural life fashionable here as it is in England. When the English tradesman or manufacturer has made his fortune, he immediately seeks the country and becomes a landed proprietor. To possess a country place is a sure indication of prosperity and success. It frequently opens the social door to his family which otherwise they could never hope to enter. Our American farmer, and village merchant, take a different view. He and his family often spend their best years working and saving, in the hope of one day being able to reside in that mecca of their ambition—the

city. If we must adopt English customs, in the name of all that is sensible and sweet and sane, let us cultivate the English love of rural life. To do this we must make our rural regions lovable and attractive. English roads, and walks, and hedgerows, cannot be made in a season, but not one of us is too poor or too busy to do something to improve our premises. Plant a tree where shade is needed; set a shrub in that ugly corner; trim out the undergrowth, and keep the grass cut. Lend a hand to help your wife or your mother with her flower-bed, and praise it, too! When I see a bright patch of flowers growing near a dull little farm-house, I feel like lifting my hat to the woman within. She may be poor and plain, but in her soul there lives a love of beauty, and color, and fragrance, to which I gladly do reverence. Everything which makes for happiness and contentment adds a note of music to the harmony of life.

The importance of keeping the women of our households cheerful and happy and healthy cannot be overestimated. If the daughter of the house goes away to school and absorbs something of art, music, literature or science, let her be generous in bestowing the riches of her attainments on the home circle, not in a way to irritate and embarrass, by reminding them of their own defects in education and opportunity, but with a heart-felt desire to give them happiness, and to apply her accomplishments to improving and beautifying the home. Many a hard-working, self-sacrificing mother, doing her homely tasks day by day, is soul-starved for sympathy and appreciation which her worldly minded daughter is too thoughtless to give. Make the mothers happy. If the counterpart of the "Man with the Hoe" exists in America, he is the outgrowth of industrial and agricultural misfortune. Hard, unremunerative labor may always be depended upon to breed discontent and degradation. If we would lessen the number of this class, we must cure conditions which kill and degrade a man, whether his sphere be the mine, the mill or the farm. We must encourage legitimate industries. We must establish agriculture as a permanent and self-respecting profession in which the wisest and strongest may engage with pleasure and profit. Agriculture that is conducted by weaklings will decay and degenerate. The hoe and the hammer, the pen and the paint-brush have each a part to play in the world's work; and it is my hope and belief that

in the enlightened judgment of the future each will be accorded equal honor if wielded well.

The regeneration of the race must come through the energy and heroism of the plain people if it come at all. It will not come in any sudden, miraculous fashion, but must be the slow, sure growth of civic honesty and brotherly love. Let us all, then, pledge our best endeavors—

> "To build with song again
> The broken hopes of men;
> To hush and heroize the world
> Beneath the flag of Brotherhood unfurled."

State Agricultural Society.

By W. B. TOOLEY, Cornell University, Ithaca, N. Y.

ITS HISTORY BRIEFLY OUTLINED.

[Other brief sketches of the history of the New York State Agricultural Society may be found in the first volume of the transactions of the society, in the report of the U. S. Commissioner of Agriculture, 1875, and in volume II of Public Service of the State of New York, edited by Hon. Paul A. Chadbourne, D. D., LL. D. Also a history of the farmers' institute movement may be found in the volume of Transactions for 1895.]

Now, at the beginning of the Twentieth century and at the time of a great crisis in the history of the New York State Agricultural Society, is a fitting occasion to look back over its previous history and to note the influence it has exerted in improving the condition of the American farmer.

The present society has grown from the work of earlier organizations. In 1791, there was organized "at a meeting of a respectable number of citizens at the Senate Chamber in the city of New York" a "Society instituted in the State of New York for the promotion of Agriculture, Arts and Manufactures," and Chancellor Livingston was chosen president. The chief object contemplated by this Society as then organized was the publication of practical papers. May 1, 1804, the original charter expired. In the new charter, which was granted April 2d of that year, the name was changed to a "Society for the Promotion of Useful Arts in the State of New York." The Society was, however, practically unchanged, although it was intended that, besides the original object, namely, that of publishing practical papers, the organization should establish an experiment station and found a library. Neither of these objects, however, was effected. The four volumes of Transactions in which the above mentioned papers were published appeared in parts and at irregular intervals from 1792 to 1819, etc. The first and second volumes deal

largelv with Agricultural subjects, the third deals almost entirely with mechanics, while the fourth volume is miscellaneous in character. Among the contributors may be named Robert R. Livingston, Ezra L'Hommedieu, Samuel L. Mitchell and Simeon DeWitt. These men laid the foundation of a great work, but the society they founded was not destined to carry it further; for in 1824 it "lost its agricultural character and became merged in the Albany Institute."

In the meantime the agricultural interests of the State were transferred to another organization. April 7, 1819, the Legislature appropriated $10,000 per annum for two successive years to be awarded to farmers in premiums by the county agricultural societies which should raise an equal amount by voluntary subscription. The act further provided that each county society should choose one member to a board of agriculture which should annually publish a volume at the expense of the State "to be distributed to the good people." The board organized January 10, 1820; and, the annual appropriation being extended to six years, continued its work until April, 1825. Three volumes, similar in character to the Transactions of the former society were published in 1821, 1823 and 1826.

In February, 1832, eighty-seven "zealous and enlightened friends of agriculture" met at an "agricultural convention" in the capitol and organized the New York State Agricultural Society with LeRay deChaumont as president. April 26, 1832, seven years after the Board of Agriculture went out of existence, this new society was incorporated by act of the Legislature. The chief work of the society as then organized was the publication of agricultural essays, although at the second meeting, February, 1833, a memorial was presented to the Legislature asking that provision be made for an agricultural school, and a resolution was adopted that a fair be held in Albany and also in New York during the following autumn. Accordingly, on the second Thursday of October, 1833, the New York State Agricultural Society held at Albany its first and only fair until after its reorganization in 1841. This fair, it was said, "although the first, fully met public expectation." The agricultural essays referred to above, together with the proceedings of the society were published in the "Cultivator," a monthly journal founded by the society and circu-

lated among the farmers at a nominal price. The first number appeared March, 1833, with Jesse Buel, J. P. Beekman, and J. D. Wasson as committee of publication. The Cultivator soon became the individual enterprise of Jesse Buel and shortly after his death was combined with the Genesee Farmer under the editorship of Willis Gaylord and Luther Tucker. In the pages of this journal were printed the foremost agricultural thought of the time, and many articles, especially those of advice to young farmers, are of great value even at the present day.

However lasting the influence of the society through the pages of the Cultivator may have been, for several years little else was done save the holding of annual meetings in Albany. Gradually the members became dissatisfied with these petty results, and the more progressive thinkers began to see that the society must start its work on a new basis. February 10, 1841, a reorganization was effected and the following suggestive clause inserted in the constitution: "The society shall hold an annual cattle show and fair." This movement owed its success to the indefatigable exertions of a few men, among whom may be mentioned Ezra P. Prentice, Luther Tucker, Benjamin P. Johnson, Joel B. Nott, Alexander Walsh and J. J. Viele. The success of their efforts was due, first, to an act of the Legislature appropriating the sum of $8,000 for the term of five years for the promotion of agriculture and household manufactures in the State. This amount was apportioned as equitably as might be among the county societies, and $700 was allowed the State Society. Another strong factor tending toward the success of this new movement was the annual fair made possible by the above appropriation.

These fairs, beginning at Syracuse, September 29 and 30, 1841, have been held every year since with almost invariable success. For almost fifty years it was held at various places throughout the State. In 1889, however, the society made provision for permanent grounds at Syracuse, and there the State fair has, beginning with 1890, since been held. These fairs, by enabling the farmer to hear the thoughts and see the products of the foremost agriculturists of his day, have had an educational value which has started many a man on the road to success.

The holding of fairs, however, has not been the only great work of the State Society. In its published Transactions are

articles on almost every subject connected with agriculture, such as tillage, grasses, stock husbandry, horticulture, entomology, household arts and in the earlier days silk culture was given a prominent place. The first volume of the Transactions appeared in 1841. Thereafter the Transactions were published annually until and including the year 1871. Other volumes followed in 1876, 1882 and 1886. During the next three years three volumes were published in pamphlet form. Beginning with 1890 the proceedings of the society were published under the title of Annual Reports. Of these nine volumes have appeared. The later volumes have given quite extensive reports of contemporary agricultural and kindred societies in New York State, and since 1893 have been largely devoted to farmers' institute work.

Indeed this farmers' institute movement was started and for several years carried on by the State Agricultural Society, though now under the State Agricultural Department. Through the efforts of Professor I. P. Roberts of Cornell University and J. S. Woodward of New York a farmers' institute was held at Ithaca in January, 1886. This first attempt was so successful that the society set aside $1,050 from its funds to be used the following winter in inaugurating this movement. Accordingly during the winter of 1887, institutes were held at Lockport, Ithaca, Oswego, Batavia and Schenectady. The success of the movement exceeded the expectation of even the most optimistic among its supporters, and later results have given ample proof of its value to the New York farmer.

Beside the work already enumerated, the society has conducted extensive trials of agricultural implements and machinery. It appointed commissioners to enquire into the cause and treatment of contagious diseases, among which may be mentioned the contagious pleuro-pneumonia of 1859, the rinderpest of 1886, the plague of bovine abortion in 1867, and the epizoötic apatha of 1870. These were promptly taken in hand and valuable work done for the live stock interests of the country. Another matter of historic interest is the publication, 1850 to 1873, of a monthly journal in which appeared the work of the various committees, current events and other brief matters of agricultural interest. In mentioning the factors which have contributed to the success of the New York State Agricultural Society, the annual meeting

in January must not be forgotten. Here the strongest men of our State have met together for a common purpose, namely, that of helping the farmer to a better condition in life. This is a noble work, and it has been nobly done.

At the present time it seems that this grand old organization is on the wane. The State Agricultural Department has little by little taken unto itself the work of the society until, to quote from a leading agricultural journal, "last year there was nothing left for the State Society but the management of the State fair." Difficulties of a financial nature, which need not be mentioned here, have also presented themselves. It is to be hoped that, these difficulties passed, new work will be found and the New York State Agricultural Society may again flourish as in days of old.

Farming on the Island of Jersey.

By F. S. Peer, Author of "Soiling, Ensilage and Stable Construction."

To say the peasant farmers on the Island of Jersey (many of whom can neither read nor write) are the best and most scientific farmers in the world, sounds like a contradictory statement, a very boastful one to say the least. I make the statement on my own account, for I have never heard it said of them nor do the islanders set up any such claim. They are quite unconscious of the fact themselves, as only a very small proportion have ever been away from home to the extent of crossing the channel that separates the island from France or England. I call them the best farmers in the world for the simple reason that they make their farms produce more per acre than any other farmers I ever saw or heard of. To grow large crops on land that has been under cultivation since long before "the morning stars sang together" may be called the art agriculture, and if, as Lockhardt says, the science of farming is to take large crops from the soil and leave the soil in better condition for the succeeding crop than it was before the crop was taken, then of all men the peasant farmers of the channel islands must be considered most scientific, for the fertility of their farms has steadily increased to meet the requirements of their increasing numbers and their increasing wants.

The little Island of Jersey is only fourteen miles long and four to seven miles wide, a good sized western farm. There is, however, a resident population of 55,000, and that this island is able to support its own inhabitants and feed 40,000 to 50,000 visitors annually, is something wonderful. When I tell you that in addition to this there is exported from the island yearly between three and four million dollars worth of farm and garden produce, no one will question that these island farmers deserve the distinction that I have given them.

Early potatoes and cattle are the principal farm products; the potato crop alone that was shipped from the island this year brought £445,872 or $2,175,855. There is on the island, all told, about 25,000 acres. There is of course a great deal of waste land along the coast so that there is only about 10,000 acres of land worked or tilled by farmers. There are 1,200 farmers and the average sized farm therefore is about eight and a half acres. On an eight-acre farm there will be, say four and a half to five acres of potatoes (followed by a crop of roots same season) an acre or acre and a half of grass, and on the balance of the farm, oats or meadow, garden and buildings. The farmers pay from forty to seventy-five dollars per acre annual rent, and 300 bushels of early (partially grown) potatoes is considered a good crop, while 400 bushels and even more is not uncommon. I am afraid to tell the truth as to the number of tons of mangolds that are produced per acre, after the potato crop, without additional fertilizers.

How is it possible to grow such crops on such a small piece of land, support such a large population and export over three million dollars worth of produce yearly, at the same time to increase the fertility of the soil so as to produce such crops? I reply by keeping a large number of live stock for the manufacture of barn-yard manure. Incredible as it may seem, on these 10,000 acres there are owned—according to the last census—11,891 Jerseys, 2,343 horses, or 14,234 head of stock, to say nothing of pigs and poultry. The farmers buy some commercial fertilizers and draw a great many tons of sea weeds gathered on the sands when the tide is out which they spread on their meadows and grass land, but their principal reliance is barnyard and liquid manure. I doubt if there is a farm on the island without a liquid manure cistern, the contents of which is pumped into a hogshead, on a two-wheeled cart and distributed on the grass and meadows.

But how can they feed such a great number of cattle from so small an acreage of grass land, when potatoes and other crops occupy about two-thirds or three-quarters of the land, where 14,234 head of live stock is nearly an animal and a half per acre for every acre farmed? By adopting a strict soiling system only the milch cows are allowed to go to pasture; these are soiled or

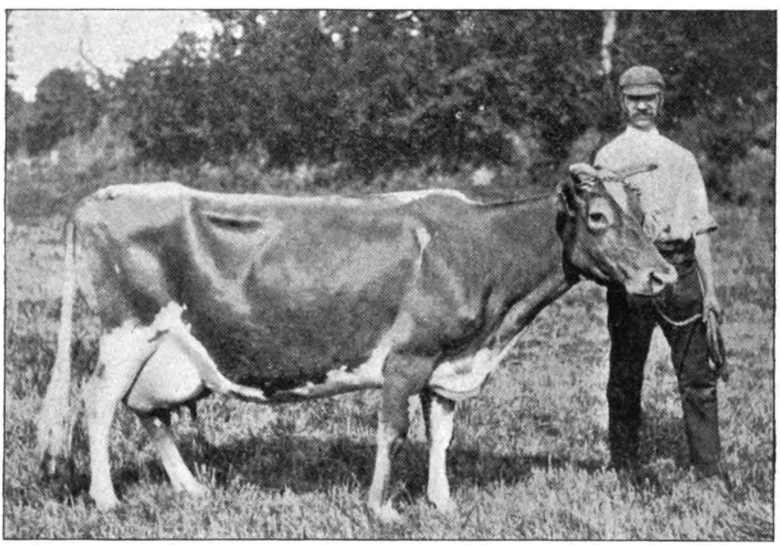
tethered out, beginning at one end of a field; each cow mows her own swath across it. She is moved on once or twice a day according to the size of the grass and makes a clean sweep of everything within reach of her leather rope, which is about twelve feet long. The growth of grass is something wonderful. The cattle feed across these fields six or eight times during the season, and even then portions of the field often gets the start of them and is cut for hay. All the young things are kept in the stables and fed on roots. Mangolds are also fed night and morning to the milch cows that are usually housed during the night. Roots are probably 75 to 80 per cent. of a cow's feed during her lifetime on the island. In the winter she gets in addition a little hay, possibly two pounds, night and morning. Not only are these islanders the best and most scientific farmers, but their system of selecting and breeding is also ahead of that of any other community. It has brought to that little island millions of dollars and is likely to continue to do so for generations to come. Nevertheless they are largely without books or education. I doubt if there are over a dozen copies of agricultural papers subscribed for by the farmers on the island. How can their great skill as farmers, breeders and gardeners be accounted for? Their methods in some respects are very primitive and have doubtless been handed down to them from the teachings of pious monks who were said to be very learned men and particularly fond of agriculture. They experimented and taught it to the young men and orphans who were brought under their influence. The ruins of several Dervish temples of great antiquity still remain as evidence of these priestly orders. While their pupils were kept purposely ignorant of all book learning they profited by the lessons of their learned teachers. This probably is the foundation of their agricultural training, but necessity has been the great teacher. How to feed their ever increasing numbers has been the problem, and this has been accomplished only by keeping the greatest number of cattle making the greatest amount of barnyard and liquid manure, which, as before stated, is made possible by adopting a strict soiling system.

Plowing.

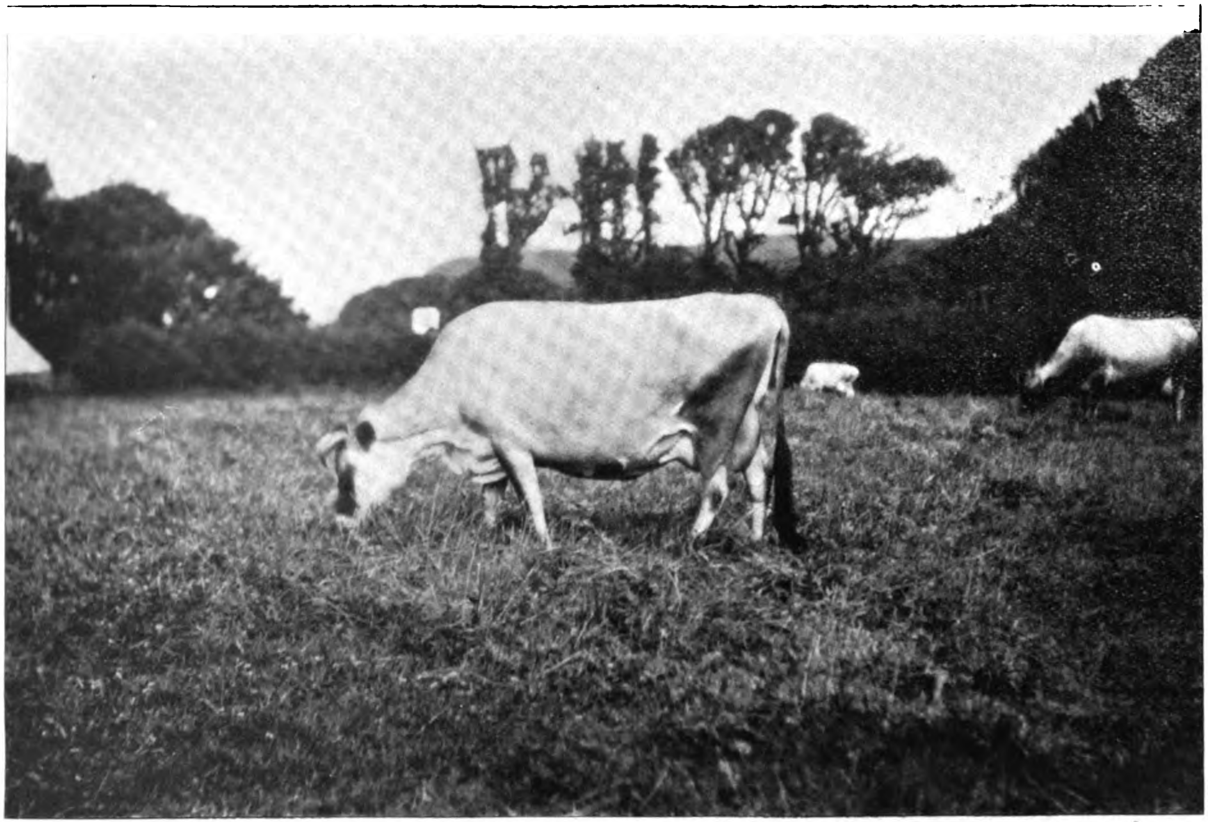
I have said the islanders were the most scientific farmers, yet if I could show you one of their plows, you would laugh. It is anything but a scientific implement, for instead of the long, graceful, easy lines of a modern light draft American plow, it is very large and heavy, with the mould board about as blunt as it is possible to make it. It takes six horses to draw one of these plows, but if it is not scientifically built it does most scientific work. While an American plow turns a furrow that is so easy and gradual that the ground is barely cracked in the turning, the islander's plow, pulverizes the ground thoroughly. The plowing season is the great event of the year, the farmers changing work, as no one man has horses enough to do the job properly. First they plow a furrow about four inches deep and fourteen inches wide with four horses; then a heavier plow follows in the same furrow with six, seven and sometimes eight horses attached. This plow goes eight to ten inches deeper and the same width as the lighter plow. The ground is so thoroughly pulverized that nothing more is done to it except that boys and men walk along the furrow and knock to pieces any lumps that work to the surface. The whole seed bed from top to bottom of the furrow (twelve to fourteen inches) is more like an ash heap than a plowed field; no harrowing is needed, not a foot touches it until the day for planting; in fact it would be almost impossible for a horse to travel across it.

Planting Potatoes.

"The spuds," as they call the seed potatoes, are carefully lifted from the ground where they are left to ripen. Later they are sorted and set, with the eye-end up, in trays. These trays are corded away in some outbuilding adjoining the stables, and by spring there is one strong sprout an inch and a half or two inches long growing out of this eye end. These trays are carted to the field and the potatoes planted by hand, one at a time. First a line is stretched across the field and men with shovels throw out a trench, using the line as a guide. Women follow and dust a little commercial fertilizer along the trench; other women and boys come on with a tray of potatoes and set each one upright in the row. The trench is about four inches deep, so that the sprout on the potato is very near the top of the ground when covered.



Guernsey cow, Vrangue's Favorite IV 1923, P. S., R. G. A. S. Property of Alfred Le Patourel, La Ramee, Island of Guernsey.



How the cattle are tethered.

Islanders ready to plow.

A picturesque roadway, Island of Jersey.

An artistic corner in an Islander's home.

This planted trench is filled by the ground taken from the next trench. The potatoes are always planted whole, five or six inches apart in the row, and rows ten to fourteen inches apart. In four or five days—if the weather is favorable—you can see a leaf breaking through the ground so that one can distinguish the rows. The cultivating is done mostly by hand, as the rows are too narrow to admit using a horse; however, some of the larger farmers plant so as to cultivate with horses. It is no uncommon sight to see a man and a woman or three women hitched tandem to a cultivator and at work in this way day after day.

When an American has spent a few weeks on the Island of Jersey and sees the enormous crops they take from the soil it makes him think that as farmers in America we hardly know our agricultural A, B, C's, and that with all our Agricultural College Experiment Stations, patented machinery, books and learning, we are way behind the times in knowing how to increase and maintain the fertility of our farms. Is that saying too much? Let me call your attention to the fact that the average wheat and corn yield in America has steadily declined until it is only about thirteen bushels per acre.

What do we know about agriculture in America compared with these unlettered islanders? Nothing. Any fool can rob his farm of its fertility and live for a time off of the fatness of a virgin soil, but it takes a farmer, an agriculturist, to restore it, to increase it and to "farm it" so as to win it back to productiveness with ever increasing power.

I can not close this article without calling the reader's attention once more to the prime cause of the islanders' success, i. e.: The great number of cattle they keep, which means a great quantity of manure, which means great crops, all which is made possible by adopting the soiling system for their cattle. I may also add that there is no system or farm practice that will teach a person the art and science of agriculture in this country, as will the adoption of a strict soiling system for his cattle. First of all, it enables him to keep four or five head of stock on land where by pasturing he could support but one. This means that he is producing four or five times as much fertilizer (barnyard manure) in quantity as formerly and at least ten times as

much when the quality is taken into account. This enables him to grow larger crops each year. Instead of spending half of his profits for commercial fertilizers, he manufactures his own. He sees, as he never saw before, the necessity of increasing the fertility of his farm. He discovers that the first essential to successful farming is to feed his growing crops liberally; not to see how little he can do for them, but how much. Instead of trying to get something from nothing he turns squarely about and the manufacture of barnyard and liquid manure absorbs his attention to an extent he never dreamed of before. There is nothing in the world like the adoption of a strict soiling system to teach any man, be he learned or ignorant, the true principles of agriculture, and it is to this one thing, i. e. "Soiling" (forced upon them by necessity) that makes the channel island farmers the best and most scientific agriculturists in the world.

The Ideal and Real in Life.

By Ella F. Flanders, DeWittville, N. Y.

Although this is a very practical world, and the tendencies of the men and women in it lean mainly toward the practical side; yet sentiment is not a rare thing, and ideals are as numerous as reals.

We are all castle builders. All in youth had a fairy ship at sea freighted with the brightest hopes and possibilities our youthful fancy could picture, but to none of us perhaps has come the realization of our fond day-dreams. Our castles may have crumbled into dust, and our ships, like the fairy phantom ship of old, may still hang in the horizon, never advancing toward us.

Our realizations have perhaps been very different from our anticipations, yet for all this, our high ideals have urged us to a higher plane of thought and action. Every result of importance must exist in the mind before it can exist in reality. The beautiful statue was an ideal hidden away in uncut marble until the sculptor's chisel set it free. The poet's masterpiece was but a floating dream until with patient art he brought it forth. Columbus reared a castle and started in search of it. It was only an aircastle when Morse pictured to himself the lightning, carrying news from place to place, but through his effort it became a reality. "Dreaming comes before labor, but labor alone makes it worthy." Youth is the period when we live most in the world of fancy and idealism. Henry W. Longfellow tells us

"Each man's chimney is his golden milestone,
Is the central point from which he measures every distance;
Through the gateway of the world around him
In his farthest wanderings still he sees it,
Hears the talking flame, the answering night wind as he heard them
When he sat with those who were but are not;
Happy he whom neither wealth nor fashion,
Nor the march of the encroaching city drives an exile
From the hearth of his ancestral homestead.
We may build more splendid habitations,
Fill our rooms with paintings and with sculptures,
But we cannot buy with gold
The old associations."

The wisest and best in all ages, too, unite in telling us that from our early homes emanate the most potent and far-reaching influences of life. We may wander far and wide, life may bring us the best of all she has to give—friends, influence and wealth—yet nothing interests us so much as the scenes and friends of childhood. If the child's mind be like wax, to receive impressions, it is also like adamant to retain them.

It is related concerning the eminent French writer, Victor Hugo, as he lay dying, and all France bent low to catch the whisper of his words that he spoke almost invariably in Spanish and of his happy boyhood days spent in Spain. As the light in his eyes grew dim, the gifted man dreamed only of his boyhood when he wandered care-free, and the world thinks of Hugo to-day, not at the pinacle of his power as one of the best writers of his time, but as a man loving above everything else, the memories of a happy childhood.

In the quiet and seclusion of home our children form their best ideals. How important then that these influences are the best; how important that the general line be one of the highest culture and refinement, that the moral and religious character be considered of the gravest import.

A few years ago I read that wonderful book, "The Greatest Thing in the World," by Prof. Henry Drummond. I was so absorbed in it that I read it not once, but twice. It has found its way into several foreign languages; and the thoughts on right living and the great universal law of love to all mankind are unsurpassed. It is a great thing to be able to live at our best, particularly in our homes.

In no profession perhaps is the difference between the ideal and the real more apparent than in that of farming. It is to many a pleasing ideal to picture themselves on a fine well-tilled farm, surrounded by fruitful orchards, well-kept gardens and fertile fields. But it is decidedly practical, in these times of close competition and scarcity of capable help, to the man whose brain must devise the best ways of tilling his soil, caring for his fruit, and rearing his stock so as to give to himself and family a fair and remunerative return for labor expended.

We sometimes hear the expression, "Farmers are ignorant." Concerning this a recent publication says: "Are they? Indeed!

In forms and fashions and artificialities they may be lacking, but in respect to good solid knowledge the successful practical farmer of to-day becomes a sort of encyclopedia. He is practically a "physiologist, a veterinarian, a botanist, an entomologist, even a chemist;" at the same time he is a mechanic, learning the care and use of machinery. Truly there is no class that needs or possesses such varied and practical knowledge as agriculturists. By many they are underestimated, but Longfellow very sagely says: "I do not pity the misery of a man underplaced, that will right itself presently; but I pity the man overplaced."

Farm homes are preëminently places where self-culture may receive its highest incentives. The primary reason for this is the fact that there are fewer outside influences to distract the mind. Many complain of the isolation, and say farm life is lonely and out of the world. This is certainly true to those who make no effort to form a "Home out of a Household," but to the men and women who provide their families with the best newspapers and books which can now be purchased at comparatively small expense; to those who provide home entertainment for their children, who in short live at their best, the farm home offers excellent advantages for the early training of good citizens. When we learn from statistics that nine-tenths of the crimes in the world are committed between sunset and sunrise, we need be thankful that our farm children are away from the proximity of associations which draw them from home.

Some complain that it is too hard, involving too much care and labor; now this reminds me of a little advice given many years ago. A young man wrote to Henry Clay, I think it was, asking his advice in regard to the choice of a profession. "I want something that will be easy," wrote the young man. The answer that he received was very much like this: "My young friend, don't choose the law; some of our hardest worked men are lawyers. Don't choose medicine; there is a great amount of labor involved there. Don't choose the ministry; a successful pastor is a very busy man. Don't be an editor or an author; many work hard for years before they are fairly recognized. Don't be a scientist or explorer, there is nothing easy about that. Alas, my boy, in this busy work-a-day world there is small chance for the young man who makes his ease first in consideration. History

records it as a fact that the successful men and women are the busy ones."

I was impressed with this fact when recently reading the biographies of the new representatives in Congress, who took their seats for the first time on December 4th. Many of these new members are emphatically self-made men. The number of country-born members representing city districts is surprising. It brings to memory, says the Buffalo Express, the fact that most of the presidents of the United States—in fact most of the country's greatest men were country born. Truly, many, very many, of the most useful men and women the world has ever known have passed out from the culture and quiet of farm homes to mingle with the world—thereby ennobling and enriching all with whom they came in contact.

In a recent publication I noticed this article: Among the moss-grown, stereotyped jokes in the great cities, none is more popular than that which refers to the farmer as a "hayseed," and makes sundry more or less humorous reflections on his ignorance of worldly ways. But when you come down to the solid facts, the city chap is not so torrid after all; and what he does not know about the most simple and natural things would fill a book. Even in cultured Boston, the "Hub of the Universe," where wisdom abounds and knowledge has its home, this ignorance is astounding. Some time ago a large number of school children were examined on various subjects, and some of the results were startling. Thirty-three per cent. of these children on entering school had never seen a live chicken, 51 per cent. had never seen a robin, 75 per cent. had never seen a growing strawberry, 71 per cent. of the Boston children had never seen growing beans, even in "bean-eating Boston." Their school text-books are based on country life, and the city child knows nothing in the large cities of the real life there. In the face of these facts one can readily understand how it is possible for many of our farm boys and girls to compete fairly and often outstrip those bred in the city, when placed side by side with them, which is a conceded fact by many of our best educators.

The knowledge gained by daily association with the flowers and plants, the birds and bees, the fields and the animals feeding quietly therein, broaden and enrich the childish minds, and

make them more receptive to practical knowledge. We live in a State of whose people and institutions we may well be proud. She stands first in professional education, and one of the first in all general education. The farmers are not neglected. There is a special course on agriculture at Cornell University, there is a home course of instruction, of recent introduction, where the student may pursue his studies at home. There is the Experiment Station at Geneva, from which are sent valuable bulletins to all farmers desiring them, free of charge. Prof. W. H. Jordan of this station, has secured a very strong corps of scientific workers. Mr. Harding of Wisconsin, has been secured as dairy bacteriologist, he having given especial attention to the study of bacteria, both in this country and in Europe. Mr. George A. Smith of varied and wide experience, has been secured as dairy expert. There are farmers' institutes at the expense of the State, where experts are sent to deliver lectures and answer questions.

A successful farmer must keep up with the times. He must not stay at home and sit by the fire, and wonder what they are talking about down at that farmers' institute, and what those professors will have to say. He must go down with questions, and paper and pencil in hand and make the best of his advantages. He must not be contented to farm merely as his father and grandfather did before him. Times have changed, and he must study the value of fertilizers, and when the suave phosphate agent comes along, must know something of the value of various phosphates, which he can find from the helpful bulletins sent out, and know that he does not take sand for a good specimen, nor should he be so easily overruled as to neglect the valuable fertilizing elements of his own farm, and buy instead a commercial fertilizer of doubtful value.

Past National Master Brigham, at the National Grange, held in Harrisburg two years ago, stated that the development of the farmers' bulletins had been most rapid. Special appropriations were first made for them by Congress, the members of which are entitled to two-thirds of the number printed for distribution. Soon, however, members of Congress solicited and obtained nearly four-fifths of the total number, more than 2,400,000 copies; an increase of half a million over the year previous were then printed, and the demand bids fair very soon to exceed the supply.

These are encouraging signs of the times, and when we read that nearly forty per cent. of the voting population are farmers, and may decide the result of every election, it is of great importance that their power be wisely exercised.

Farmers' organizations aid greatly in concentrating force. In Michigan particularly, there are many prosperous and influential farmers' clubs. Probably no other state in the Union has so many. Several years ago these clubs were brought together into a State organization, which has proved remarkably successful. It is safe to say no other organization in the State has a greater influence upon legislation; and the result has been one of the cleanest administrations that the State has known for some time. It is strictly non-partisan in its demands and suggestions. The power of combined farmers seems almost unlimited if exercised in the right direction.

We are accustomed to look upon the American railroad system as of almost paramount importance in the interests of the country; but I was much interested some little time ago in reading the report which the Interstate Commerce Commission had just issued. By comparing the railroad figures with those of the agricultural products for the same year, it was found that only the corn crop of one year would be sufficient to pay all the railroad wages and salaries for 1896, and leave a surplus of more than $98,000,000. The railroad business does not begin to compare in magnitude with that of agriculture. In fact, the railroad, like all other business enterprises, lives on the products of the soil and its money is made by handling and sorting what farmers have grown and others have handled.

I have recently read several articles on the lack of good reading in our farm homes. Now, from my own knowledge I think many of these homes are as liberally supplied with good reading as are many of those who are following other professions. That there is a general lack in the majority of all homes of a careful study of current topics, and a general knowledge of the life around us is a fact to be deplored. Children who are early taught in the home to become interested in the forms of government and those who govern, are forming the basis of good citizenship. Many housewives and mothers complain of their utter

inability to find time to read much, although papers and books may abound.

No one with a practical knowledge of the average home-life denies that the housekeepers of the present day, often with incapable help, and many of them with none at all, are decidedly busy people; but we read women cannot do too much to make home attractive. Every investment to this end is better than one in the bank. Just in proportion as we make our homes happy may we hope to save our children from outside snares and devices.

Although "Cleanliness may be next to Godliness," even this can be overdone. We all admire well-kept homes; where the carpets are bright and free from dust; where the polished floors are always clean; where the china and silver never grow dull and tarnished, and where the dust never forms on the immaculate upholstery; but if this commendable state of affairs be reached only by the mistress of the home becoming a veritable household drudge, it is purchased at a great sacrifice. If the wearied mistress of this beautiful home has no time to read, no time to cultivate flowers, no time to visit her neighbors, no time to amuse and instruct her children, no time to be an agreeable, social companion to her husband, then indeed the neatness which is commendable has deteriorated into the neatness that is detestable.

The majority of our farm homes are happy ones, where the best lessons of all our lives are learned; but while we as housewives and mothers are careful lest the dust gather in our homes, let us remember the wholesome words of Dora Read Goodale:

"Don't let the dust gather on your ideals, they are the best part of your mental furniture. Don't let the dust gather on your enthusiasm. Don't let the dust gather on your vows—your church vows, your marriage vows. They are as real, as binding, as when the good pastor laid his hand on your head, as when you stood at the altar with the man that you loved. Don't let the dust gather on your blessing; a diamond covered with dust seems no better than a stone."

We are told that history repeats itself; if this be true then the boys and girls in our farm homes to-day are, many of them, those to whom the nation looks to bear the grave responsibilities of the

future. It behooves us then as earnest thinking men and women to guard well these homes. To put forth our best efforts to make them places of peace and refuge. Places where life's best ideals are formed, fostered in growth by love and care, and sent out into the world around us there to become blessed realities, helpful in this life and in that other life which is eternal.

Does Farming Pay?

By Rev. O. T. Fletcher, Altamont, N. Y.

Judging from certain conditions as they prevail to-day one might conclude that farming did not pay. That conclusion is easily arrived at if one considers only the fact of the exodus of the population from the country to the city, or the heavily mortgaged condition of the great majority of the farming property of the State, or the run-down condition of so many farms, or the low price of farm produce and the high price of farm labor and farm machinery; and, along with these facts, hears the farmers' cry of "hard times," "poor crops," and "heavy taxes." These things would seem to say, "Farming does not pay."

But not by these signs alone can the question be correctly answered. The profitableness of farming depends upon two factors, viz.: the farm and the farmer. And the former depends for its worth as a factor upon the ability of the latter. The State recognizes this fact and is seeking to make farming a more profitable business by improving, not the farm, but the farmer. The State hopes to enhance the value of farming to the farmer, not by lessening taxes or by giving bounties, but by equipping the farmer for better work.

There are three kinds of farmers who never make farming pay. Farming does not pay to the indolent farmer. The man that is lazy cannot succeed on the farm. Nor can those fellows who sit around the corner grocery or blacksmith shop and cry "hard times" when they ought to be at work. Away back in the beginning, God said to the first man, "In the sweat of thy face shalt thou eat bread." What wonder is it that he doesn't have it, if he doesn't sweat for it.

Ben Franklin, you know, said:

"He that by the plow would thrive,
Himself must either hold or drive."

My father had no conflict with Dr. Franklin but he taught us boys that

> "He that by the plow would thrive,
> Himself must always hold and drive,"

and that from early till late without soldiering. If a man is no friend of work he had better not attempt to make farming pay. He may do well enough under a boss, but the farmer who succeeds must not need driving to his work or to be watched to be kept at it. He who succeeds must have ambition enough to work and work hard. Laziness never succeeds—except in being lazy. In farming as in every other business it pays to hustle. Farming will not pay if you don't try to make it.

Farming does not pay to the indifferent farmer. You can generally tell a farmer by his farm. It is easy enough to tell if a man is interested in his work. The farmer that likes to till the soil puts something of his soul as well as his mind and muscle into his toil. He cares for things and takes delight in them. It pays to take good care of the stock. It pays to keep up the fences. It pays to keep the shingles on the roof and the doors on the hinges. Every successful farmer knows that. It doesn't pay to leave the plow in the furrow from December to May. It doesn't pay to leave machinery out in the weather from one end of the year to the other. It pays to keep the trees in bearing condition and the soil fit for a crop. Indifference in regard to these things precludes success. The man who doesn't care, doesn't make farming pay. Carelessness costs; pains pay.

Farming does not pay to the ignorant farmer. The advice one artist gave to a younger one was:

"Mix your brains with your paint." Mix your brains with the soil, is no less good counsel to the farmers of to-day. It is more needed to-day than ever. Farming is developing into a scientific process. To-day the more a man knows about farming in all of its branches the better farmer he will be and the better success he will make. Brains are the best fertilizers. The hope of farming is the education of the farmer. Thinking and studying along the line of one's work pays in every line of business. Mind is worth more than muscle. Intelligence enhances the worth of a ditch-digger. Farming is no narrow field for study and experiment. Think of the variety of soils and the things one must know

to determine the best crop to raise and the ingredients necessary in the soil for the best results. Consider the various and great variety of things a man ought to know about stock. What shouldn't he know about horticulture and plant life? He should know something of seeds and fruits; of markets and the things which influence them; of methods, means and machinery. He should be something of a chemist, a botanist, a horticulturist, a mechanic, a political economist and a veterinarian. He has been all too long just a digger in earth and a horse jockey. But thanks to the printing press, the district school, and the awakening generally to the fact, old as Solomon, that "The man of knowledge increaseth strength." The successful farmer is a man of no mean ability. He has ambition, enthusiasm and intelligence. To such men farming pays. It pays, although it may not at first thought seem to. Pay is not always to be reckoned in terms of dollars and cents. I am sure farming so pays. I am of the opinion that the man who cannot make farming pay wouldn't make anything pay of which he was the manager. Too many have an idea that farming requires neither industry nor intelligence. It is a dangerous fallacy that a man can run a farm when he can do nothing else. There was a time when almost anyone could do well on a farm, but that was when the soil was rich in its virgin fertility, markets good, and competition small. It is not so now.

But money is only one consideration. There are other things of greater worth than bank accounts for relatives and children to quarrel over and squander. Perhaps more money can be made in other pursuits, but there are some advantages which more than make good the loss. These we must consider in determining the profitableness of farming; for that must be reckoned both in terms of money and manhood, of wealth and health, of currency and character. The loss in one is often compensated by the other. In one section of the State there may be most money in raising grain; in another, fruit; in another, hops; in another in producing milk; but in every section the tiller of the soil has the advantage over his city friend in location, occupation and association.

His location is being rid of its disadvantages by the telephone and telegraph; by cheaper, but good books and periodicals; by labor-saving machinery; by steam roads and trolley roads and by

many modern inventions whereby the benefits of the best things are placed within his reach. On the score of health the farm out-classes the factory. The farmer eats pure food, drinks pure milk, slakes his thirst with water of crystal purity as it bubbles out of the hillside clear and cool, breathes the purest air, and inhales the invigorating fragrance of nature's richest perfume; his nerves are saved the strain of the ceaseless hum of factory noises and the commotion and confusion of commerce; he spends his days in God's sweet sunshine and his nights in the radiance of his own fireside. His brother toiler in the city knows none of these, except at rare intervals. His food is not always fresh, nor his surroundings conducive to good health or long life. The man on the farm comes near to nature and receives the virtue of the touch. He looks into the blue sky and star-studded heavens; he sees the rose as it buds and blooms, living things as they grow; he hears the songs of birds and breathes the perfume of apple blossoms and the scent of new-mown hay; and in his home he enjoys the comforts of art and music. His children are blessed with vigor; his home comes near the ideal. It was Burns the poet of the farm who gave the world "The Cotter's Saturday Night." For home life there is no place like the farm. For the training of children and the developing of noble manhood there is no place like the farm. By location, occupation and association it is the place for laying the foundation of a good intellectual development; the place for building up a strong constitution; the place for establishing the framework of a noble character. Think of the privileges and opportunities of farm life: Those long winter evenings for social and intellectual improvement; those hours of solitude and quiet. What times for thought, and reflection, and study! What moments for meditation on things divine and eternal! What aspirations, what inspirations as he communes with mother-earth! What liberty is his! What freedom! No wonder we are a free people. The sense of freedom was born in the soul of the farmer. It was a lot of farmers led by a farmer who repelled the foe at Lexington and Bunker Hill, at Brandywine and Yorktown.

It is said of Anteaus that no one could throw him in wrestling except Hercules who succeeded only by first lifting him from contact with the ground; his strength came from contact with

the earth. With the farmers rest the future of this republic. From the farm have come the men of might who have filled places of trust. One-third of the present Congress is from the farm. More than half our presidents were farmers' sons. To the country must we look for the strength to replenish the wasted energy and vitality of the city. After three or four generations the strenuous activity of city life and public service consumes the strength derived from contact with the soil. It is from the soil that men have received that impetus, that inspiration, that ambition, that industry, that manhood, that character, that strength of body, mind and will that gave them power to outstrip their fellows in the race for lofty service. Such being the worth of rural life, it pays to till the soil.

Question Box.

[This interesting feature of our institute meetings is yearly growing in popularity, and justly so, for in the "Question Box" is brought out the practical side of farm life, expounded by active and progressive farmers whose experiences and practices cannot help benefiting brother farmers. However, it is impossible to give, in the small space at our disposal, the "Question Box" of each institute, where so many are held, for to do this would require a special work in itself. Again, not all questions asked are of general interest, the majority being of a local nature, and frequently the same questions are asked and answered at various institutes; so that we have endeavored to select from an almost interminable mass of manuscript questions and answers which, if they do not contain new ideas and suggestions, will, at least, act as reminders and furnish food for thought and mental digestion.]

POTATOES.

How do you fight bugs?

Mr. Litchard.—I pulverize 100 pounds of plaster and thoroughly mix with it one pound of paris green. As soon as the plants are well up, sprinkle the mixture on the hills. This will kill the "shell backs" to a large extent and prevent the appearance, in great measure, of the slugs.

What condition of soil do you favor for potatoes?

Mr. Litchard.—A good, well-fertilized and fitted clover sod, plowed seven to ten inches deep and thoroughly fined to a depth of at least five inches, and the surface as free as possible from stones and clods.

What variety of clover do you sow?

Answer.—Medium red and alsike, two quarts of the former and four quarts of the latter.

What do you do to prevent scab?

Answer.—Scab is a fungous growth. It may be in the soil. Do not plant seed that is scabby, nor plant clean potatoes on

land where scabby tubers grew the year before. A preventive is to soak the seed potatoes in a solution of corrosive sublimate and water, two ounces of the poison dissolved in fifty gallons of water. Soak the seed an hour and a half, but never leave a scabby potato lying on the ground, nor put one into the cellar. Boiling the scabby tubers will destroy the germs so that they will not infest the soil if they are thrown on the ground. The cooked potatoes may then be fed.

What variety of early potatoes do you prefer?

Answer.—Early Puritan, Early Sunrise and some others are all good with me. It is well to study the habits of different varieties and adopt those which are best suited to your soils, climate and conditions. Begin in a small way and, if you are successful, like to grow the crop and can market it profitably, enlarge your field.

Do you use a digger, or dig by hand power?

Answer.—I use a digger drawn by four horses and put the tubers into the cellar for one and a half cents per bushel. This is a great saving in the expense incurred over the old way, and enables me to sell my crop a little less, if necessary, and still make a fair profit.

Speaking of prices, he said that an investigation made recently revealed to him the fact that the average price of potatoes in his county had been forty-five cents and a fraction for ten years. He also said that his crop had averaged him 125 bushels during the last ten years. He also said that the general average yield of potatoes is but seventy-six and one-half bushels per acre and that of wheat twenty-two and one-half bushels. He also gave the average yields of some other crops, and told the per cent. of nitrogen, potash and phosphoric acid removed from an acre by these crops, all which showed that potatoes removed less fertility than does wheat or beans. He also favored potato growing for the reason that one has a money crop to dispose of in winter when we do not get much from the dairy. Therefore he grows potatoes in preference to wheat or beans.

What varieties do you raise?

Answer.—It has come closer to the question of form or shape, round potatoes being most in demand and at better prices. My preference is Rural New Yorker No. 2, Carman No. 3 and Sir Walter Raleigh. They all belong to the same family and are known as round potatoes.

Do you roll the sod after plowing it?

Answer.—Yes, we use a heavy roller—one weighing 1,750 pounds—and let it lap one-half. This packs the furrows hard. After this we harrow deeply and make the seed bed fine. We plow the clover sod sometimes as deep as ten inches; this when the field has been worked down deeply and well manured. If it has not, we do not plow so deeply.

Can blight on potatoes be prevented by spraying? What do you use?

Mr. Litchard.—It may be prevented, but then there is no cure. Spraying has been practiced through the State with the Bordeaux mixture. Some make two applications; some three. Scab is another disease and is a soil germ. The best way is not to plant seed that has any scab on it. Don't put any scabby potatoes in the cellar nor plant them on land where scabby potatoes grew the year before.

Mr. Cook.—Soak the seed potatoes in a solution made by dissolving two ounces of corrosive sublimate in fifty gallons of water. Leave them in the solution two hours.

Which is better, hill up or use level culture with potatoes?

Answer.—It will depend somewhat on the soil. As a rule nearly level culture is best.

When one has land that is adapted to both wheat and potatoes, which will be the better money crop?

Answer.—Wheat will take the most fertility from the land. One hundred bushels will remove $29.50 worth of it; potatoes, $5.20. The man who knows how to grow potatoes will get the most money from potatoes.

What is the best method of growing potatoes near Madrid?

A Farmer.—I do not raise many potatoes, but I plow my land deeply, turning under as much manure as I can. The rows are furrowed out three feet apart and the seed dropped eighteen inches apart. I grow from 300 to 400 bushels per acre, and have no trouble in growing smooth, handsome potatoes. But the main point is in having good seed. My land is a limestone soil, which produces good potatoes.

Mr. Litchard.—We raise a good many potatoes in our county, and we find a dry, loamy soil the best, both for quantity and quality. We prefer a clover sod, either for corn or potatoes. Since we have our silo, we follow potatoes with corn. Our manure is all drawn out as fast as made and spread on the sod.

Mr. Pickens gave his method, which did not vary much from Mr. Litchard's, although he uses a hiller, while Mr. Litchard does not.

Mr. Litchard.—There are three essential things necessary to grow potatoes: First, soil; second, seed; third, sense; but the best results are obtained when the crop receives constant cultivation; so I never would put in a shovel plow, for the reason that it cuts off the small feeding roots. Give only level shallow cultivation.

Will the planting of ill-shaped potatoes produce the same?

Answer.—In the main, yes. As a rule, one gets about that which he plants or sows.

At what season would you advise planting potatoes for the local markets?

Answer.—Be governed by climatic conditions and soils. If you are in a high altitude, get the seed into the ground as early as possible. We want to have them ripe before the early fall frosts.

To Dr. Jordan.—What is the cause and remedy for scab on potatoes?

Answer.—The germ that causes scab on potatoes lives in the soil. I am not a bacteriologist. We ought to have about twenty men in a force to answer all the questions that come up. The soaking of the seed in a solution of corrosive sublimate, one part

of the poison to 1,000 of water, is said to prevent it. It is caused by an alkaline condition of the soil. Lime and wood ashes contribute to it.

To Mr. Terry.—Will lime, used on land, cause scab on potatoes?

Mr. Terry.—Dr. Jordan says that an alkaline condition is favorable to the appearance of potato scab. Lime contributes to it. We know that the scab germ will continue in the soil at least three seasons. If the germ is in the soil no amount of soaking of the seed will prevent scab on the tubers.

Will Mr. Terry tell us his experience in spraying potatoes, also tell us what implements he uses to furrow out his potato rows?

Answer.—I began spraying potatoes several years since, using a horse-power pump. Have used both a planter and a device of my own. The latter has proved best, which plows the furrows—two at once, throwing them in an opposite way; the seed is then dropped in the furrows, then levelled with the harrow. It costs more than it does to use the Aspinwall planter, probably one dollar per acre, but it pays.

What do you say about plowing under rye for potatoes?

Answer.—I prefer clover, for the reason that it furnishes nitrogen from both tops and roots, also humus, which potatoes need. Rye will produce humus, but no nitrogen for the potatoes. But there is more danger from plowing under a large crop of rye than of clover, because there is more danger of producing acid in the soil. I would most certainly try clover in preference to rye.

What variety of potato is the best for market?

A Farmer.—Green Mountain, of late, has proved best. We raised last year, 4,000 bushels. Some fields yielded 240 bushels per acre. We have also grown Carman No. 3. It is good, but does not produce as heavily as does Green Mountain or Rural New Yorker. In fact, the two are so nearly alike that one is sold for the other by some farmers. On some soils, last year, Green Mountain was much more scabby than were some other varieties.

Mr. Cook.—The difference may have been caused by differences in the soil, it being a germ which is more prevalent in some soils and in some seasons than in others.

Mr. Terry.—The conditions last year were more favorable than this for developing the blight, which as a rule caused the difference in results. With us, Carman No. 3 and Rural New Yorker are the two great market varieties. But we never plant any seed until after it has been treated with corrosive sublimate to kill any scab germs. We use two ounces of the sublimate dissolved in fifteen gallons of water, in which the seed is soaked an hour and a half. There is another preparation known as "Formaline," in which the seed is soaked. I have never used this, however. Be careful in using the sublimate, as it is a deadly poison, and do not allow any live-stock to drink from the vessels used; also be careful and pour the poison water where it will do no harm, nor should you put any treated seed in boxes or barrels which have contained scabby seed. Nor would I plant potatoes in ground where scabby tubers grew the year before.

To Mr. Van Alstyne.—Will hen manure if used alone when planting potatoes burn the seed?

Answer.—There is some danger, particularly when the season is dry. The same is true of commercial fertilizers. I would not allow either to come in contact with the cut seed.

How should we use phosphates, on top or under potatoes?

Answer.—My practice has been to broadcast the fertilizer, then, sometimes, to make a second application at the time of the last cultivation.

Is it safe to use hen manure and wood ashes on potatoes when planting them?

Answer.—I would not use the ashes; they seem to have a tendency to cause scabby tubers; nor would I mix them with hen manure because they will liberate the nitrogen in the manure and allow it to escape in the form of ammonia. I would apply the two separately, unless I were going to plow them under at once. South-Carolina rock would be better to use with the manure,

because we would get a good supply of phosphoric acid, which, as a rule, is most needed.

To Mr. Chapman.—Which shall we do, plant potatoes deeply or shallow?

Answer.—In a large number of experiments made at the stations in the United States, results showed that about four inches gave best results. A depth of eight inches has given good results; so has a depth of but two inches; but the average was not as good as from those planted four inches deep.

What is the essential thing to be sought for in growing potatoes?

Answer.—I believe that it is to obtain a strong, vigorous, healthy growth of leaf. The tuber makes the most of its growth during the last two weeks, therefore there must be a good supply of starch in the leaf to send down to the tuber. If the foliage has been eaten by bugs or has become blighted, this supply will be cut off.

Which variety of potatoes is most valuable, and why?

Answer.—Round potatoes bring more in the market than do long ones. The Carmans are the favorite now, Rural New Yorker seems to be running out; but there are some dealers who are selling any round variety they have for Carmans.

What can I do to prevent wire worms working in potatoes?

Answer.—Plow the ground in the fall, just before it freezes, and give a short rotation of crops, to destroy the worms.

Mr. Hardy.—My potatoes were worm eaten, but a neighbor planted corn-cobs in his potato hills. The worms left the potatoes and congregated on the cobs. I saw them, myself. The potatoes were clean, and I shall try the experiment myself this year.

Mr. Converse.—That might do in the garden, but I would not care to try it on two or three acres.

What variety of potatoes give the best returns on clay soil, on hillside land?

Mr. Cook.—How many of you grow potatoes? (Nearly every hand went up.)

A Farmer.—Carman Nos. 1 and 3 are best.

Another Farmer.—Rural New Yorker does best with me, but Uncle Sam is another good one. There's a week's difference in the season of Carman Nos. 1 and 3.

To Mr. Van Alstyne.—How do you plow potatoes, and how do you grow them?

Answer.—I plow as deeply as I can, for potatoes. On most of our soil I plow about nine inches—we want coolness and moisture. We plant in drills, putting the seed in about five inches then use the smoothing harrow, followed with the weeder, then the cultivator deeply, at first, then at a shallow depth, thus giving practically level culture, no hilling is done and the feeding roots are left undisturbed.

Potato planting—deep or shallow—which? In hills or drills?

Mr. Terry.—On land that is well drained—which should be on all land for potatoes, I think that four inches is the best depth; which means four inches below the surface when leveled off, after planting. We cannot afford to tear off the roots when cultivating, which results when the seed is put in the ground near the surface, in check rows, and the hilling process is followed, so we practice drill-culture. In this way the tubers are kept under, so they are not sunburned.

How about sulphur to prevent scab on potatoes? How shall we use it?

Mr. Terry.—It has been used for the purpose by dropping it in the hills. We prefer the corrosive sublimate, however.

Which are best for seed—whole or cut potatoes?

Mr. Converse.—As a rule, the largest potato growers cut their seed, leaving two or three eyes on each piece. But the seed potatoes should be kept where they will not sprout before planting time. I would not plant too small potatoes nor too large ones. Cut seed will be found most profitable.

How can we grow 300 bushels of potatoes per acre?

Mr. Cook.—With us the first fault is an improper preparation of the soil and the need of humus and fertilizers. Potato soil should be deeply plowed, well pulverized and fertilized. The next trouble is poor seed. Seed potatoes ought never to be al-

lowed to sprout in the cellar, because it injures their vitality. The third reason is neglect of the crop when the fungus and bugs attack the vines. If a good crop of tubers is secured, there must be a good, strong healthy growth of leaf and stem. To obtain that, the seed must be good, the cultivation proper and constant and the vines sprayed with the Bordeaux and the poison, to forestall the blight fungus and the bugs.

How should we dispose of our small potatoes?

Mr. Cook.—Feed them in moderate quantities to the cows, providing they assist in balancing the ration. They are rich in starch, so should be fed with protein foods. There is succulence enough in them. A few oats, some bran or cotton seed meal will balance them. If you have ensilage, take it out, but I would not feed more than a peck at first; possibly the amount may be increased a little at a time, till more are fed. It will depend on the cows's ability to digest and assimilate them, together with the other foods eaten with them.

Should ground be rolled before dragging for potatoes?

Mr. Converse.—I would certainly roll a clover sod, to pack the furrows closely. Then I would finely pulverize it and fine the surface before planting the potatoes.

What is the value of potatoes as a milk-producing food?

Mr. Litchard.—Fed judiciously—that is, not too many, and with other proper foods—I think they are worth for such a purpose eleven cents a bushel.

Mr. Cook.—When potatoes are worth twenty-five cents a bushel the question is not worth considering. I used to think that potatoes could not be fed and good butter and cheese made, but I have changed my mind somewhat. Begin with two quarts and increase the quantity gradually up to a peck or more, when they are low enough in price.

What is the best potato digger on the market?

Mr. Litchard.—The Hoover is the best digger I have tried so far. But there may be a better one, however.

To Mr. Fenner.—Do you plow your potato ground more than once?

Answer.—No, sir; we do not plow it but once. In Erie county we do not farm for amusement. But we fit the ground well; then thoroughly cultivate the crop.

HORSES.

When should a horse be watered, and how much should he have?

Dr. Smead.—As a rule, when the horse wants water let him have it, using good judgment in the amount he takes and the condition he is in. If he is very thirsty and hot, allow him to drink but a few swallows at a time, but have the intervals short. I never saw the horse nor the time when I would not give him some water. Exercise the same judgment you would with yourself. If a man or woman is wise, they will take a swallow or two, at a time, at intervals. You may crave a quart, but do not drink it. The stomach of the horse holds but about three gallons, so it is of no use to allow him to swallow more; if he does it will not pass through the stomach.

Should horses have a hay ration before eating their grain?

Dr. Smead.—As a rule, yes, as the coarse food already eaten will prevent the grain compacting in the stomach. At the same time it will be more easily digested than if fed before the hay ration is eaten.

Is rye a good food for horses?

Dr. Smead.—I may run afoul of a snag, but I shall say no. If I had rye I would sell it and buy something else. It is not at all suited to the ordinary horse.

Would you grind oats?

Dr. Smead.—Not, if the horse had good grinders. I would prefer to let him do the grinding, instead of taking the oats to the mill and take my chance of bringing him an indefinite quantity.

Is there anything better than good oats to feed horses, ordinarily, in connection with timothy hay?

Mr. Litchard.—I would take off a part of the oats and substitute bran in place of them. The horse, like other animals, relishes a variety, and will thrive better than when fed all the time on one food.

What foods are best for a colt during the winter?

Mr. Litchard.—Good clover hay and oats.

Dr. Smead.—Mixed hay, red clover, alsike and timothy, cut when the red clover is in bloom, is best. Such hay has a nutritive ratio of about 1 to 7. Feed the colt what it will eat in an hour. No more. If more, his digestion will be impaired. For the grain, half a pint of oats and a fourth of a pound of bran to each 100 pounds of colt, will do.

Please give a good ration for a horse?

Mr. Ward.—It would depend somewhat whether the horse was being worked or not. Such a horse would require a different ration from one standing idle. There is no better grain food than oats. If the hay fed is clover and the grain, oats and bran, a little corn meal should be added, but don't feed too much timothy hay, only just what will be eaten up clean in an hour.

If you were going to feed corn and oats to a horse would you feed both grains whole?

Dr. Smead.—No, I would grind them together, because corn ought not to be fed whole. But I would not feed corn and oats mixed, because I find at least one horse in thirty that cannot eat corn at all; if a horse can stand it, there is no better feed for a horse doing heavy work than corn and oats mixed about half and half.

What is the best ration for young colts?

Mr. Van Dreser.—I know of nothing better than wheat bran, oats and clover hay; skimmed milk is also good. We fed wheat bran with it and made a growth of over 60 pounds in 30 days. Not more than a pint of oats, three times a day, was fed.

What is the feeding value of buckwheat straw for horses? Will they eat it?

Mr. Ward.—Horses will eat good, bright clean buckwheat straw in preference to hay. It is one of the best foods for horses; they will eat it readily. But it must be clean, bright and well housed. I do not recall its nutritive ratio, so that I cannot tell just how it compares in feeding value with other straws.

Should salt and ashes be fed to a horse?

Dr. Smead.—Salt has a good effect on liver and some other organs, and should be given in small amounts. We find that some wild animals, such as deer, eat it, and our domestic animals do the same. So I would give it to them. So far as ashes are concerned I will say, "don't feed ashes." We use the lye from them, in connection with grease, to make soap. If an animal swallows ashes, the lye from them when the liquids of the stomach release it, cannot help but injure the animal.

Is it essential for horses or cattle to be groomed every day and the stables cleaned every day?

Mr. Cook.—Clean the horse stables every day and put the manure behind the cows in the gutters; then groom the horses. Do it every day.

THE PIG STY.

What is the best feed for young pigs?

Mr. Litchard.—Milk first, then mix wheat middlings with it.

Mr. Cook.—When they are a little older throw in a little whole corn, and I would add a little oil meal to the ration of the young pigs.

A Farmer.—The best pigs I ever saw were fed barley meal.

Mr. Smith.—Skimmed milk and wheat middlings make a good combination. Don't feed them wheat bran; a little cracked corn will make a good mixture; not much, but some of it, as the pigs seem to like it very much.

Will it pay to grow rape for hogs?

Mr. Ward.—Yes; decidedly. One of the largest swine breeders in our county grows a large quantity of it for his hogs, and says it pays better than grain. But do not feed it to milch cows, as it taints their milk. Horses will not eat it, but every other animal on the farm will.

Has the Geneva Station had any experience with the Tamworth breed of hogs?

Dr. Jordan.—We have a Tamworth male in our pens and are crossing him on the Jersey Red. It has less hair and we believe the cross will make a good bacon pig. Some farmers object to

the long nose of the Tamworth, but I do not care for that. We cannot afford to grow pork for packing here; its day has gone in this State. Bacon for home use and export is now in best demand.

To Mr. Cook.—At what age would you slaughter a pig, fattened, for most profit?

Answer.—It would depend very much on what I had to feed him, and the price of foods as well as that of dressed pork. Where one has good, sweet separator skim-milk or sweet whey, with wheat middlings as a starter, to be followed with some one of the fattening foods, the cost would be less than where all the foods were bought. At present price for foods and pork, however, I think that 150 pounds, dressed weight, would be about the limit. I do not believe one could afford to grow a pig above that weight.

If you could keep but one breed of hogs, what would it be?

Abel F. Stevens.—The "White Victoria."

What is the value of whey for feeding purposes?

Mr. Cook.—Whey is worth a good deal more than we get out of it, as a rule. About one-half of the total solids of the milk when made into cheese pass off in the whey. All the milk sugar—about five pounds—the albumen, the ash, some fat and a small per cent. of caseine, making fully six pounds, go into the whey vat. When this whey is used just as it comes from the cheese vat, if it be fed to pigs, with wheat middlings, fully seven cents per hundred pounds may be got out of it. As a rule, however, we do not get half that. I have experimented and know that whey is worth more for feeding pigs than for any other purpose. If you will, next spring, spend the time you do in figuring down the making price of cheese a fraction of a cent, and use it in devising some method of better utilizing the whey product, you will be better paid. It is almost a perfectly balanced food, that is, the solids of it. But, as there are but six pounds of these solids in 100 pounds of whey, the balance being water, it will be seen there is only a small per cent. of the whole that is valuable.

Mr. Van Wagenen.—We are feeding buckwheat middlings and skim-milk to pigs, in preference to corn meal. It is not right theoretically, but, when we can buy buckwheat middlings for $12 per ton as against corn meal at $18, we are satisfied it pays to let the pigs burn protein instead of carbohydrates in their bodies. Understand, I am not advising this, except one is situated just as we are and the same market conditions prevail.

CONCERNING CALVES.

How many pounds of milk will it require to fatten an ordinary veal calf?

Mr. Windecker.—I estimate it at 20 pounds a day. At six weeks it would amount to $6. All above $7 for a calf at that age is profit. The estimate is on the basis of 150 pounds weight for the calf, with milk at $1 per hundred pounds.

Mr. Smith.—When calves bring but 4 cents a pound, the cost will be more, will it not?

A Farmer.—It would depend upon the calf. A small one would not develop up to that price—$7.

Mr. Windecker.—I would not start a small calf. It would not be worth fattening.

The Farmer.—I have experimented with two calves. The first week I fed two and one-half quarts of milk per day, the second week three quarts, the third week four, and the fourth week five quarts. These figures are for one feed. They should be doubled for 24 hours. The calves weighed 276 pounds, gaining two and one-half pounds per day the last week.

Is it profitable to feed whey as it comes from the factory to calves three to six months old?

Mr. Cook.—It is not profitable to feed some whey to calves; it depends on its condition. The milk sugar all goes into the whey, about four pounds in a hundred; then there is the ash and a small per cent. of fat, making in all about six pounds of solids. If the whey vats are kept scalded and the whey barrel clean at home it will pay to feed whey. If these conditions do not obtain it does not pay to feed it at all; it is a by-product and should be saved. The Standard Oil Company is now making the most of its money out of that which it once threw away

What is the best method in which to feed calves linseed meal?

A Farmer.—Put it into the milk and let them drink it.

Mr. Sampson.—I think it is better to cook it.

Mr. Litchard.—I saw it being fed in Henry Stevens' barn, at Lacona, to calves. They brought it cooked to the barn and added the milk to it.

Dr. Smead.—I have seen calves injured by feeding them linseed meal. I prefer to feed, first the milk and then either feed the ground flaxseed or the flaxseed oil. We want to add something to the milk to replace the butter-fat removed from it by skimming. I prefer, at first, a little jelly made of the linseed meal. It is not necessary to cook it, because it has been cooked in the process of extracting the oil from the seed. Later, when the calf has begun to eat something solid, the meal may be fed. It is dangerous to feed linseed meal to calves a week old.

What is the best feed for calves when one has not enough milk?

Mr. Cook.—Give the young calf, if it is worth raising, its mother's milk for the first two or three weeks, then gradually work off on to skimmed milk with some ground oats, wheat middlings and a little oil meal mixed with it. A little good sweet whey, with the foregoing grains mixed with it, makes a good ration. Our sweet whey paid us fully 7 cents per 100 pounds when fed in that way. But, if I were going to feed Jersey milk to young calves, I would take out some of the fat through the separator to prevent scours, which very rich milk induces. I believe that if one were going to raise calves, he could do no better than to go out and buy the thinnest, poorest Holstein milker he could find, and then feed that cow's milk unskimmed, to the calves.

Which is preferable, to raise calves or veal, or sell them?

Mr. Ward.—It will depend. If the calves are ordinary scrubs, veal and get rid of them just as soon as possible. Don't keep such calves on the farm a day longer than is needed to get them ready for the butcher. But, if they are good full bloods and have the requisites for making good cows, raise them.

Does it pay to veal heifer calves on a small farm?

Mr. Harding.—I buy young calves from milkmen, feed them milk from my herd till they are four or five weeks old, then sell them for veals, because I can get good pay for my surplus milk. Have got more money from my cows, through veals than I could from butter, unless I got a very fancy price for it. If, however, I had a good heifer calf from a good mother, I would raise it.

Can young calves be raised on separator milk alone, and how should it be fed?

Mr. Dawley.—I wish that every calf could have all the sweet skim-milk with some fine wheat middlings, oat flakes and a little oil meal it wants, the last named to replace, in part, the butter fat taken out of the milk. There will be no trouble experienced in raising a calf on good sweet, separator skimmed milk, with flax-seed jelly added in small quantities.

THE ORCHARD.

Which is the most profitable commercial pear?

Mr. Wood.—To-day Kieffer is my most profitable pear, with Bartlett next.

Mr. Hooker.—Dutchess has brought, all things considered, the highest prices so far as I am informed, when it was put in cold storage, held till late, then shipped to Europe, if well assorted and packed. It returned last season to some shippers as much as $13 a barrel. I believe it the most profitable pear to-day, when well grown and well packed and shipped.

Mr. Willard favored Kieffer and said there is no variety so good for canning to-day as a well-grown, matured New-York Kieffer. The Kieffers grown in the south and southwest are not fully developed. Their flavor is not developed in the can as is that from the New-York grown Kieffer.

What is the most valuable Japan plum from a commercial standpoint?

Mr. Smith of Geneva.—Our best Japans for commercial purposes are Wickson and Burbank. In our orchards on Seneca lake, Wickson is doing well. Although we have been fruiting it but three years, we have learned that it pays to thin the fruit very much, as it inclines to overproduce. We sold them for as

high as $1.50 per bushel in New York last fall, when Lombards were selling there for but 50 cents.

Mr. Willard.—Red June and Burbank have proved most profitable with me—of the Japan varieties. Red June ripened as early as July 17th last season. My experience with Wickson has not been so pleasant as has Mr. Smith's, but conditions differ, and it may yet become one of the most valuable varieties of the Japanese plums. With me, all things consider, Burbank has been the most profitable of these varieties.

What about October Purple?

Answer.—I have fruited it several years, but would not recommend the planting of it very largely.

By Mr. Jennings.—Is it a truth that the Japan varieties are more immune from the ravages of curculio than are the European or our native varieties?

Answer.—I have never found them so, although I have watched them very carefully.

What of some of our native sorts?

Answer.—Hudson River Purple is doing quite well in western New York, but it is more subject to attacks of blackknot than are some others. I have been top-working some of my trees of that variety with something else, because of this defect.

Are there any new peaches of value?

Mr. Taber.—I would like to know if any one has had any experience with Fitzgerald.

Mr. Anderson of Geneva.—I have a few trees, which came from Canada. They have fruited. It is not very satisfactory. The last season the fruit was fine, however. The season is a little later than Early Crawford.

Mr. Willard.—Its quality is good. Mr. Morrell of Benton Harbor, Michigan, has made careful tests of the hardiness of fruit of several varieties, and has found this one ranking best.

What about Crosby?

Mr. Willard.—We have fruited it and found it very satisfactory. We have shipped it to Port Jervis and elsewhere, where it gave excellent satisfaction.

Mr. King.—It has not proved, so far, satisfactory with us. I live near Trumansburg, Tompkins county.

What of Phair's Choice?

Mr. Willard.—It is a fine late peach, and it succeeds excellently on the shores of Lake Huron.

Mr. Barns.—It is being grown by some of my neighbors, and by Mr. Quinby of Marlboro. He reports it a good peach.

There were some other of the new varieties named and described by Mr. Bogue of Batavia, and other growers present. Among them Triumph, which Mr. Willard said he regarded as of not much value, notwithstanding its name.

Mr. Woodward.—There is a seedling of Crawford in Niagara county which is better than Crawford in every respect. It has been named Niagara, and I would not plant a Crawford if I could get this seedling.

Another new variety, known as Willard, is said to be one of the best of the new sorts, its season being a little later than Crawford.

What of the Windsor cherry, one of the new varieties?

Mr. Willard.—It was introduced by Ellwanger & Barry. As a market fruit it stands pre-eminent as a sweet cherry.. None has ever been introduced that approaches it. I have 50 trees. They are young, but they have already paid for themselves, the expenses of growing and caring for them, and the interest on the land they stand on. The fruit is large, hard and good. I can take three or four bites out of one. It sells well, the market price having been raised from 10 to 12 cents per pound last season.

George T. Powell.—Mr. Willard has left out one valuable quality, that of health and constitutional vigor. It has the power to withstand insect and climatic attacks, such as Black Tartarian, Black Eagle and some other sorts of like character and season, do not. Therefore I regard Windsor superior to all others in this respect. Then, too, it begins ripening in July, from the 6th to the 10th with me in the Hudson river valley, and keeps a long time. So it goes early into market and brings good prices.

What of the new variety of cherry known as Bing?

Mr. Willard.—I have it. The scions came from Oregon. It has fruited one year. Some of the specimens had a circumference of 3 to 3½ inches. It is the most promising of any of the newer varieties that I have. The man who has that and the Windsor will be a happy one. Montgomery is the most valuable sour cherry, with English Morrillo second.

Which variety of currant is best to plant?

Mr. Willard.—There are some new varieties not long since introduced that are among the best. Among them is President Wilder, a red variety, and White Imperial. The latter is not a commercial variety, but it has no equal as a table currant. I have grown Wilder a number of years. It produces on my grounds double the quarts yielded by Cherry or Fay, while the quality is very much finer than that of either of these old sorts. The children who pick our currants easily double their wages when they begin picking it.

George T. Powell.—I have taken as many as 16 quarts of Fay from a single bush. If Mr. Willard can beat that, I would like to know it.

Mr. Willard.—I take off my hat to that statement from Mr. Powell, and go to the rear.

W. D. Barns.—I do not feel confident to decide which is the best commercial variety to plant. Many currants are grown along the Hudson river. Fay drops its fruit, gets dirty, and is straggling somewhat in its wood growth, while Cherry is infested with disease. The old Victoria is a good one, but is not fully satisfactory for one or two reasons. Prince Albert is the latest to fruit of any in my grounds, but its color is light and therefore objectionable to some. President Wilder gives the best satisfaction so far. It is an upright grower, and the fruit hangs on longer, and is still fit for market, than does that of any other variety. I have several thousands of bushels of this variety, and the fruit has averaged two to four cents per quart higher in the market than any other variety, the color being fine and the quality fully as high, while the yield is much larger.

George T. Powell.—Currants at present are one of the most valuable of the small fruits which I grow, but there are some

drawbacks. The currant worm is one, but it may be easily controlled. There are some other insect pests, some of them of recent date, that can not be so easily fought. There is a growing demand for the fruit, however, so that the grower can afford to be vigilant.

Will Dr. Van Slyke tell us what is the most hardy plum for this cold climate (Springville)?

Dr. Van Slyke.—I don't know everything. You will have to write to Prof. Beach, the horticulturist at the Geneva Experiment Station, for an answer.

Mr. Fenner.—I think that some of the Japan varieties would do best in this locality.

Mr. Converse.—These Jap plums are quite hardy with us in southern Jefferson county.

I desire information about grapes. Mine are on low, black soil, but do not bear fruit. But the vines make a large growth every year. Why do I not get more fruit?

Mr. Stevens, Mass.—That is a text for a long sermon. Undoubtedly the conditions of the soil are not good. Too much nitrogenous foods in the soil, or it may be the rose bug chafer. I could tell better if I could see the vines in foliage. A black soil is not fitted for the grape. Fertilize well with potash and phosphoric acid, and avoid too much growth of wood and foliage.

Mr. Van Alstyne.—What is the variety?

The writer of the question.—Rodger's Hybrid. It is a black grape.

Mr. Van Alstyne.—Write to the Geneva Experiment Station for their bulletin describing the various varieties and giving some directions for caring for them.

Is there any danger from an overproduction of good apples?

Mr. Van Alstyne.—As a rule, there is not an overplus of good apples. The "overplus," is of poor fruit. Sometimes a lack of proper distribution causes an overplus in some one place; but, during the last three years, we have had good, profitable prices, and the outlook, to me, for good prices, is still better. The German and southern markets is now opening up, and the rates of transportation are lower. Beside that, there is a constant in-

crease in the insect pests, which will drive out many fruit-growers, who will not be thorough in fighting the pests. But the presence of the pear-tree psylla, San José scale, scab, fungus and blight, will so demoralize some growers as to cause them to let their orchards go, and those who persist to the end will reap good profits for their investment and work. Certainly, I would if I wanted them, set pear trees now.

What is the best preventive of borers in fruit trees?

A Farmer.—Dig them out with a wire.

Dr. Smead.—A bandage of wire gauze put around a tree will keep them out. It should extend down under the surface of the soil a trifle.

What is the present outlook for apple-growing?

C. M. Hooker.—It is at present very encouraging. Three years of remunerative prices, with fairly good crops, make the outlook much better. Western New-York apples rank best everywhere. We are learning every year how better to grow apples and how to fight insects and fungus. Of varieties he said he has found the old ones still the best, although he, at his age, would not plant Baldwins; a young man should, however. Ben Davis is also a good commercial variety.

Mr. Wood.—I now have great confidence in the apple. It is the king of all our native fruits and has saved my life financially. Roxbury Russet with me is all right, so is the old black Gilliflower.

A gentleman from Oswego said that several buyers of apples were in his place last fall and paid fifty cents more per barrel for Gilliflower than for any other variety in the market. It is rapidly coming to the front as a market apple.

Prof. Van Deman.—Western New York is the great apple-growing belt of the State and is going to grow millions and millions of barrels of the fruit in the future, and so the question of the most profitable varieties ought to be considered. To-day, Ben Davis is the business apple for our markets. People may talk about Ben Davis just as they have done and do about the Kieffer pear, but, so long as these fruits sell at good prices, and the people demand them, we should grow them. If I were going to plant an

orchard to-day, I would put in a row or two of Ben Davis, or, if I were to grow trees on which to top-work other sorts, I would plant Ben Davis. I would top-work Baldwin and King of Tompkins County on it, also Grimes' Golden. The latter is to-day the best apple in America. Its season ranges from November to New Year, but York Imperial is running an even race from Virginia to the Pacific coast with Ben Davis, and you will find that, within the next twenty years, it will have become a great favorite in your orchards here. Its only fault is its ill-shape, but that does not influence its quality at all. It ripens with Baldwin or even later. It keeps better and holds its fine flavor to the end.

If you were to set a commercial orchard, near Altamont, what varieties would you plant?

Mr. Van Alstyne.—One should be governed by soil, climate and markets. Some varieties do better on heavy soils than do others. For myself, I prefer a majority of fall varieties, Duchess, Maiden's Blush and Gravenstein are among the best for me. I also grow Red Astrachan, which is very early, and I have got more money from it during the last ten years than from any other variety I grow. Years ago I came very near top-grafting all my Astrachans to some other variety. I am now very glad I did not. Yellow Transparent is a beautiful early apple of fine flavor, and the tree is an upright grower, hardy in foliage and wood, and an early bearer, but I think the skin is too tender for a shipper. The Greening, Ben Davis, Sutton Beauty and Hubbardston are among the best winter sorts. King of Tompkins County is one of the very best winter sorts, but its root growth is deficient, so I would top work it on the Spy. Ben Davis is of poor quality but it is a fine grower, an early bearer, and is much sought after in our markets as well as in those over the water. So I grow it for the money in it, not for sentiment.

In setting an orchard, are not young, straight trees better than those two or more years old? What about pedigree trees?

Mr. Van Alstyne.—I would want straight trees, and ordinarily I think that two-year old trees are preferable, although there is no particular objection against one-year olds. So far as pedigree is concerned I am a firm believer in that. They should be propa-

gated from buds or scions from good, strong, healthy trees, with a good root system, and which bear fruit of the most perfect type. We often find a very marked difference in the shape, color and flavor of the same variety of fruit, made so by propagating the trees from inferior stock, those which had drifted away from the original type.

What is the benefit of applying salt to quince bushes? When, how and in what quantities should it be applied?

Mr. Van Alstyne.—The quince, like the cabbage, likes salt, and I think the same is true of asparagus. Salt also creates moisture, but I would use it in moderate quantities about the quince tree. I would put a quart, scattered about the trees as far as the roots extend. On very large quince trees, perhaps more may be used, but I would not apply it oftener than once in two or three years, and it will be found best on light soils.

Should we trim our pear trees the same as we do our apple trees?

Mr. Fenner.—No, sir. I have several hundred pear trees, and prune them but very little. Sometimes I cut out some of the inside branches that interlock. Pears ought not to have too much sunlight. They should be grown in the shade, then picked before they are thoroughly ripe, and left to ripen in the fruit house or cellar.

What is the best tool with which to cultivate the orchard? How about the disc harrow?

Mr. Smallwood.—I cultivate the orchard the same as I do any other field, with the spring-tooth harrow.

Mr. Cook.—We use a heavy disc harrow in place of the spring-tooth, so that quack roots will not be dragged all over the field. The harrow is heavily weighted and four horses hitched to it. You don't want a light disc harrow, but a heavy one, that will chop up all quack or other roots. Remember, quack roots make just as good humus as do any other plants; but I can kill it dead as a hammer, every time, in the way I say, first having sown a crop of oats and peas thickly, followed by one of winter wheat, seeding with clover the next spring.

How many times is it necessary to spray one orchard?

A Farmer.—Spray twice; once before the blossoms open and once after they fall, using the copperas sulphate and lime. It is what is known as the Bordeaux. Add paris green with the Bordeaux for the last spraying.

Why are Ben Davis apples such good sellers?

Mr. Gould.—Because they are red; I know of no other reason.

Mr. Cook.—They will bear some hammering, and, after all, are a very good apple. In the spring when all other varieties are gone, it does very well; the evaporator men like it because it makes a white product that is attractive in the market.

Would rape be a good crop to sow in an orchard?

Dr. Jordan.—Yes, sir. Rape would be a good crop for that purpose. Dwarf Essex is the best variety I know of. But if you sow it, fertilize both the trees and the rape, else the rape will steal fertility as well as moisture from the trees. Rape, like cabbage, requires considerable nitrogen to perfect a good crop. Do not allow it to take it from the soil at the expense of the trees.

How far apart would it be best to set peach trees here at Weedsport?

Mr. Cook.—I don't know. No one of us are peach-growers.

A Farmer.—I think it best to set them from sixteen to twenty feet apart each way.

What strawberry is best to fertilize the Bubach?

Mr. Rice.—I don't think I could answer that question for you, because strawberries are fickle. With us, however, Brandywine is best for the purpose, because both varieties blossom and ripen about the same time, are about the same size and variety, and both are good sellers. We can't get too much pollen by way of fertilization for Bubach.

A Farmer.—Brandywine, Bubach and Gandy are the best sorts here.

What new varieties are best?

Mr. Rice.—William Belt, Glen Mary, Atlantic and Marshall are all on trial with us. Marshall is one of the most beautiful straw-

berries I ever saw, and one of the best in growth, but there is so much difference in soils and climates that one cannot advise. We find that many things that do well with us do not elsewhere, only a few miles away.

Is it best to mulch strawberries till after freezing, before cultivation? Is horse manure suitable for mulching?

Mr. Talman.—I would say by all means mulch them, using wheat straw, and leave most of it on the plant, taking off just enough so that the plants will come up through it. I would not use horse manure at all.

Mr. Converse.—I have tried mulching to be left on, but I now greatly prefer cultivation to keep down the weeds and conserve moisture. I also find that it is more profitable to take off but one crop of berries from a bed, then plow it under. If a second crop is taken off, the berries are much smaller and the yield less. We mulch the new bed, or, rather, cover it in the fall with marsh hay or straw, to be raked off in the spring.

What kind of fertilizer is best for fruit trees?

Mr. Converse.—I am not an orchardist, but I have noticed in Western New York that the best orchards were those that are cultivated. Oft times that is all an orchard needs. If the trees are thrifty and are making a good growth they do not need nitrogen, and in most soils there is potash enough. If any fertilizer is required, it is phosphoric acid.

What is the average production of strawberries on well-cared-for land, per acre?

Mr. Converse.—One hundred bushels, or, say, 3,000 quarts, is a good, fair yield.

Can you give any remedy for the strawberry root louse?

Mr. Chapman.—The only remedy is to plow up the bed. I have not had it on my grounds, but have seen it in the State of Delaware. That is the remedy down there.

What is the difference in effect on the apple tree in trimming in April and October, when it is quite severe in both cases?

Mr. Converse.—I suppose that if we are to trim severely, the nearer we can do it to a full flow of sap, the better. But I have

heard Mr. Willard say that it is better to trim when the tree is at rest. It were well, however, to trim a little each year, so as not to have to cut off large limbs, and all trimming should be done closely. Do not leave the "stubs" sticking out far enough to hang hogs on when butchering day comes. When they are cut closely, if the wounds are painted over, they will soon heal.

Last year our orchard in this vicinity was treated as follows: Buckwheat was sown early and plowed under, then sown again and the crop taken off. It is proposed to plant to corn. Is it right?

Mr. Van Alstyne.—I question if it is the best plan for the orchard. It may be best for the other purposes mentioned, but we want to get the most out of the orchard we can. So we ought not to grow any crops that will take away fertility or moisture from the tree. If we are to do that, we must feed both the trees and the crop sufficiently, and I know of no better crop to grow in the orchard than corn, because we can give both the crop and the trees cultivation.

FERTILIZERS AND FERTILIZING.

Why does land plaster fail to benefit our meadows, as it formerly did?

Mr. Woodward.—As I understand it, land plaster is only a stimulant, and, after the soil has been stimulated to a certain extent, such stimulants fail to act.

Mr. Cook.—I would not draw land plaster from my depot, if it were given to me. I would buy South Carolina rock, instead. It costs but $11 per ton, and there are in it 240 pounds of phosphoric acid, worth five cents a pound, in a ton of it, thus giving us the plaster, or sulphate of lime, practically free. There will be about 1,200 pounds of plaster.

Is it economy to top-dress new meadows with barn or stable manure?

A Farmer.—I top-dress my meadows. Have meadows from which I get a ton and a half of hay from an acre, and they have been mown continuously twelve years.

Which is the best way to use nitrate of soda in a garden? How much will it require for the plants if placed around the roots?

Mr. Cook.—I would not care to say how much will be required to injure the roots, but I know that it will injure the foliage of

some plants. So I would not use but little at a time, say fifty to seventy-five pounds to the acre; but I would not use it when the foliage is wet. Wait till it is dry, then apply it close to the plants.

Mr. Dawley.—Mix your nitrate with plaster or earth, before applying.

What fertilizer is best for spinach, lettuce and celery, when one does not have stable manure?

Mr. Cook.—I do not grow these vegetables, except for family use, but I have learned that we must fertilize a crop according to its needs. Lettuce is a plant that requires much nitrogen. If enough is given, it will be tender; but there may be enough nitrogen in the soil now; that is, as much as the plant can assimilate. Therefore, it would be money thrown away to add more of this element. As a rule, there is potash enough in the soil for most crops. Phosphoric acid is usually most needed. You will get it best from South-Carolina rock. If you need more nitrogen for the crops you mention, I think that the best source will be nitrate of soda. It gives the plant an early, quick start. But, no matter what crops or plants we grow, best results are obtained from fertilizers when there is a good per cent. of humus—vegetable mold—in the soil. To know just what fertilizer is best, we must study the habits of the crop to know what it needs, then strive to provide it.

Hen manure 4 parts, fine stable manure 2 parts, wood ashes 1 part, mixed thoroughly and rotted—on what crop and how would you apply it?

Mr. Cook.—I would not make such a mixture. Leave out the ashes, as they would unlock and release all the nitrogen in the manure. Put in some South-Carolina rock and potash, then apply it at once. I believe that the ideal way to apply manure is in the fall, if one can save it all until that time; but we draw ours all out and apply it as fast as made, usually putting it on sod where we are to plant corn.

Mr. Terry.—I believe that Mr. Cook is right. We store all of our manure under a shed, and keep it wet so that there will be no loss of nitrogen by fire-fang; then draw it out and put it on our sod, in the fall. We drew out 350 loads last fall.

A Farmer.—Why not put it on the wheat?

Mr. Terry.—It would not do at all. There would be so much nitrogen in it that the wheat would all fall down; but, when it is put on the clover and the clover is cut early, it does no harm, and we get its full benefit in our potato crop next year.

Does it pay to buy manure to bring up the land?

Mr. Terry.—It would depend on the quality, what it cost and how far one would have to draw it. If I had to pay fifty cents a load for ordinary manure and draw it half a mile, I would not touch it. Too much of it, from livery stables, becomes fire-fanged, thus leaving nothing but potash and phosphoric acid in it, worth four cents a pound. If manure is made on a cement floor and all—urine included—saved, and it is directly applied to the land, it will pay to buy it and haul it a short distance, at a reasonable price. A load of such manure weighing 3,000 pounds, drawn two miles, will pay at $1.

Are wood ashes good for a clay soil? Are Canada ashes pure?

Prof. Cavanaugh.—I guess that it will be found that wood ashes are good anywhere. On clay, ashes are valuable, because they contain from 30 to 50 per cent. of lime. Good ashes will analyze four or more per cent. potash, with one per cent. phosphoric acid. But I would not buy them except on a guaranteed analysis. I think they would be most valuable on a heavy clay soil. They are worth what the potash shows up. The phosphoric acid in wood ashes runs from one to one-and-a-half per cent., but it is not all at once available for the use of the plant.

Mr. Litchard.—I buy all the wood ashes I can find; they are the best fertilizer I can obtain for my potato ground.

What per cent. of potash is there in average hardwood ashes?

Mr. Cook.—They will not average more than about four per cent. when dry and unleached. Sometimes we find a higher per cent., then a lower one, but there is a little phosphoric acid in them, possibly one and one-half per cent. The remainder consists of about forty per cent. of lime and foreign matter, so that, on sour soils, ashes have an additional value in this direction. On soils that are not sour their only value is in their potash and the small per cent. of phosphoric acid, which is slowly available.

How do hardwood ashes compare with fertilizers for oats and buckwheat, when unleached?

Dr. Van Slyke.—We cannot compare them. Ashes contain but one element—potash. Buckwheat requires a fertilizer containing other elements. Ashes at $6 per ton, containing four per cent. of potash, would not be too dear. At $10 per ton, unless one wanted lime, the cost would be too high. It were better to buy muriate or sulphate of potash for the crops named.

What harm in putting wood ashes in the drops behind the cows in the stables?

Mr. Van Alstyne.—The potash in the ashes liberates the nitrogen in the manure and allows it to escape in the form of ammonia, which is just the thing we want to save. Lime has the same effect when mixed with manure. If ashes are to be used with manure, the mixture should be applied to the soil and plowed under at once. It were better to use South-Carolina rock in the gutters, to absorb the liquids, as there will also be added a good per cent. of phosphoric acid, an element that barn manure usually lacks.

A Farmer.—Good wood ashes have proved the best fertilizer I ever bought. They have been worth at least $1 per bushel to me, but they only cost me ten cents.

Which is the cheaper to buy, manure at three or four shillings a load, or commercial fertilizers?

Mr. Converse.—There is a difference in the value of manure, and there is in that of fertilizers, but, at such prices for manure, compared with those for average commercial fertilizers, I would buy the manure.

What is the best fertilizer for clay soils?

Mr. Cook.—As a rule, clay soil has potash enough. What is most needed is the liberation of the plant food now in it, rather than to add any more. It will be a waste of money to add plant food, unless the soil has humus. There are thousands of acres of sandy soils in this country that are full of plant food, but which is not available, for the reason that there is no humus in them. To tell what elements of plant food are needed on such clay soils one

would have to watch the crops, note results and then feed the plants just what they should have.

Does it pay to let manure stay out all winter in the barn yard, when the land needs it?

Mr. Van Alstyne.—No, but we see it every day on some farms; at the same time the owners are going out and buying commercial fertilizers. This class of farmers are those who are all the time howling about their taxes, but they never stop to think that they are losing six times as much every year through the loss of their manure and the injury done to their farming tools left out of doors the year round.

With cow manure at $1 per ton, what per cent. of liquids should be credited? How can it be saved?

Mr. Converse.—I would make the floors and gutters of cement, then use absorbents in the gutters to hold the liquids. They contain sixty per cent. of the value of the voidings of the animals. Straw, horse manure, land plaster and other absorbents should be used for this purpose.

Where is the best place to buy Carolina rock? What are the prices?

Mr. Cook.—I buy it for $11 per ton, from first hands.

Mr. Fenner.—It is $14 with us. Prices seemed to vary according to localities and markets. Some is more available and has more acid in it than has others. There are several features about South-Carolina rock, and, all things considered, I believe it best to use the dissolved rock in the cow stables, behind the cows. There are from 240 to 280 pounds of phosphoric acid in a ton of the rock, with about 1,100 pounds of gypsum.

A Farmer.—We buy pure plaster here for $3.50 per ton.

What form of potash shall I buy, kainit, muriate or sulphate, for tobacco?

Mr. Cook.—Sulphate is, as a rule, worth from $8 to $10 per ton more than is the muriate. I cannot now give prices. The difference in price is in the less amount of salt in the sulphate. There is no salt in that while there is in the muriate. I don't know about kainit.

To Mr. Cook.—What per cent. of actual potash is there in muriate?

Answer.—If you buy genuine muriate of potash, in sacks just as it comes from Germany, without being opened. you will get 1,000 pounds of potash in a ton. It is the same with sulphate, but the latter costs $10 a ton more, because it has been treated with acid and the chlorine and lime removed. But I do not believe you can afford to go into the market and buy a commercial fertilizer. We can't do it in Lewis county. The first part of the question I cannot answer.

How much phosphoric acid will we get in a ton of treated South-Carolina rock?

Mr. Cook.—You will get 250 pounds of acid and 1,200 pounds of pure plaster in a ton, thus giving you the latter practically free. Save your manure. Do not buy nitrogen. If you do, buy it in nitrate of soda, dried blood or cotton seed meal.

Does it pay to plow under corn, for manure?

Mr. Terry.—There would be no fertility added; all the benefit would be in the humus, and I would much prefer rye to corn for that purpose, although that would add no nitrogen, as would clover, but it would be preferable, while clover is much better than is the rye.

Will the use of muck give humus to the soil, and can it furnish any fertilizing element?

Mr. Van Alstyne.—Muck is largely composed of decayed vegetable matter and will give us humus. There is some fertilizing value in some muck; in others not any. But it is a very good absorbent in the stables, especially in the hog pens.

In taking manure from the stable, is it best to spread it, or leave it in piles?

Mr. Converse.—Experiments go to show that in no way can there be as much value got out of manure as to draw it out as fast as it is made and spread it where it is to be used. There will be none or but little loss in disposing of it in this way.

Mr. Smith.—There is no time when there is so much fertility in manure as when it is first made and no time when it can be handled so cheaply. There can be no loss of mineral matter ex-

cept it is washed off, nor can there be any loss of nitrogen unless the temperature is raised to at least seventy degrees.

A Farmer.—I draw my manure out every day.

Mr. Cook.—I do not believe, all things considered, that there is any better time to draw out manure than the day it is made. Possibly, if it were kept till it rotted and no loss of nitrogen were allowed, it would be worth more, but the cost of caring for it would more than overbalance that item. There will be no loss of the mineral element in manure drawn out and so spread, nor none of nitrogen unless fermentation sets in, which can not take place unless the temperature gets pretty high. When you see the smoke rising from a manure heap you may know that it is nitrogen—worth fourteen cents per pound.

Mr. Hardy.—Draw it out every day it is made, and spread it. It will never be as valuable again. The loss is absolutely less when it is so disposed of than in any other way.

Would you advise putting manure on the snow on winter wheat?

A Farmer.—Draw it out and spread it on every day. Nothing will be lost from such disposal.

Which is better, to store manure in a pit or cellar until fall or draw it out and spread on the land while fresh?

Mr. Van Alstyne.—I think it much better to draw it out as fast as made, liquids and all, and spread it where it will be wanted. I would not spread it on steep hill sides, especially if they were icy, as it would wash off. Manure cellars are too expensive. Beside that, the manure, when placed in them, has to be handled twice; another expense.

Mr. Ward.—Manure drawn out as fast as made and spread on the ground will not get away, even when the ground is frozen, except it were on an icy hillside.

Dr. Van Slyke.—As a rule, nitrogen in such manure does not get away. There must be a temperature of about seventy degrees to affect nitrogen so as to change it into a soluble form. But there can be but little, if any, loss from phosphoric acid or potash, they being minerals. But in some instances there may be a slight loss from these sources. There is a little coloring matter in manure which we sometimes see running away, and

which appeals to the eye, but there is no value in it, so far as known. As a rule, manure that has been properly saved and partially rotted has a little more value than green manure.

Mr. Fenner.—I heard Prof. Roberts say that they had analyzed the coloring matter that is sometimes seen running away. It is of no value, it being tannin. There was no effect from it seen three feet from the piles of manure where they were left in the field.

Mr. Ward.—There may be a slight loss from manure when drawn out and spread in winter, at times, but the saving or expense in handling the manure as fast as made will offset any loss from leakage or otherwise.

Which would you buy for phosphoric acid, South-Carolina rock or bone?

Mr. Van Alstyne.—There is no difference in the value of the acid, but there is some nitrogen—about one and one-half per cent.—but the difference in price between rock and bone is too much to balance the item. I do not think I got any, or but very little benefit from bone.

Upon what crop should we use our manure on our hard-pan land?

Mr. Converse.—I would, if I kept cows, put it on to a good sod, then plow it and put in corn for the silo. But I would save all the manure, by which I mean liquids as well as solids. Sixty per cent. of the value of the manure is in the liquids. So I would use absorbents in the stables, then draw the manure out as rapidly as made and apply it to the land on which I wanted to grow corn.

Should we, as a rule, use a fertilizer to compare with the crop we are growing, if we do not know the analysis of the soil?

Dr. Jordan.—At the prices which rule in the market, I will say no. No farmer can afford to do it. Find out something about your soil yourself by experiment. No chemist can tell what the soil needs. He may tell how much fertility there is in the soil, but he cannot tell what is or is not available. Cornell is sending out samples of different formulated fertilizer and asking the farmers to try them and report. The farmer must study the thing himself. No scientist or farmer, however well

read or posted, can make rules for his neighbor. As a rule, however, I will recommend an application of phosphoric acid. We have acid enough. You cannot afford to buy potash now, because, 100 years hence the land may be short of it. Heavy soils have more potash than light ones, but the farmer must find out for himself. I wish that the chemist could take a sample of every soil, analyze it and tell just what the owner needed, but he does not yet know how to do it. Possibly in the far-off future he may be able to tell, but I doubt it.

A farmer present said he had harvested a larger crop of barley on land fertilized heavily with phosphoric acid, while another said he got no results from such on oats.

Dr. Jordan.—You are just adding testimony to what I have said. It all depends on the soil's need. Both of you gentlemen are on the road to righteousness. Keep right along with your experiments. I can't help you.

What is a complete fertilizer?

Dr. Jordan.—A complete fertilizer is known as one containing a greater or lesser per cent. of nitrogen, phosphoric acid and potash. An incomplete fertilizer does not contain all three, but one may use such a fertilizer on his soil that would act as a complete one, because the soil already contained the deficient element.

What is the best and at the same time the cheapest fertilizer for the farms of this section (Schenevus)?

Mr. Van Alstyne.—The best fertilizer is good barn manure, that is, that which contains the liquids as well as solids. Next comes clover with some of the green crops plowed under. When we have exhausted all our farm sources, we may buy commercial fertilizers. But I would buy the ingredients, take them home and mix them myself. Don't buy them mixed, nor be governed by the smell. Know what the analysis is of each element, and see to it that it is guaranteed. If you want nitrogen get it in the form of nitrate of soda, dried blood or cotton seed meal; if potash is required, buy the muriate; if phosphoric acid, buy dissolved South-Carolina rock. These sources will give you the needed percentages and in an available form.

How best improve a worn-out sandy soil?

Mr. Van Alstyne.—The question refers to a light soil devoid of humus. That must be present to hold moisture to get a crop. Cultivation will do it in part, but I incline to the belief that a crop of cow peas sown in June and plowed under the next spring would be a good crop. "Whipporwill" or "Clay" are the best of perhaps 20 varieties. If I did not sow the cow pea, I would try winter rye to plow under. So far as fertilizers are concerned I do not think I would buy nitrogen. If I did it would be in the form of dried blood. If I wanted potash I would buy the muriate; if phosphoric acid, I would buy dissolved South-Carolina rock; if I found the soil acid I would apply 20 bushels of slaked lime, broadcasted, per acre, to correct the acidity.

Mr. Cook.—I think that the best way would be to put on a herd of dairy cows.

What is the relation, that is, manurial value, of oats, corn, wheat bran, or wheat middlings, if either of them be fed to live-stock?

Mr. Cook.—If the voidings are all saved, there will be found most manurial value in the bran, next in the oats. There is more value in the manure made from nitrogenous than from carbonaceous foods. Corn is of the latter class, and its manurial element is quite low compared with bran. The same is true of timothy hay when compared with clover. Corn, timothy hay, the straws, cornstalks and corn ensilage are all starchy foods, and so contain but very little manurial value, while clover, wheat bran, wheat and buckwheat middlings, gluten meal, oil meal and cotton-seed meal are all nitrogenous and have nearly as much manurial as feeding value in them. Peas belong to the same class. Next, perhaps, come the oats.

What crops do you recommend as best to plow under to furnish nitrogen and humus, and what element of plant food would you apply if you did not have manure enough? Would you buy plaster?

Mr. Cook.—I would plow under clover or cow peas. Both are nitrogen-catchers from the atmosphere, which they give up to the soil, and both furnish humus, but put in the peas as soon as all danger of late spring frosts is past, and plow them under before the early autumn frosts come. You will have to watch out

for these, as the cow pea, which is a bean, not a pea, is very tender, and the first autumn frost breath cuts it down. As a rule, on most soils, for most crops, phosphoric acid is most needed. There is potash enough, as well as nitrogen, for most crops, so I would buy South-Carolina dissolved rock to get that element of plant food. I would not draw common plaster from our depot if it were given to me. The dissolved rock may be bought for just about the value of the phosphoric acid in it. There will be about 250 pounds of the acid and 1,200 pounds of plaster in a ton of it. Don't buy land plaster. It is no longer of any value on most soils. Buy the dissolved rock instead.

What is the best fertilizer for the strawberry?

Mr. Gould.—A good lot of stable manure applied in the fall; have it well rotted, then follow it with a good application of South-Carolina rock. The strawberry requires phosphoric acid, in excess of some other fruits.

What about Canada hardwood ashes?

Mr. Cook.—If you buy them, do it on a guaranteed analysis. There is a whole lot of such ashes sold that never saw Canada, and many of them are not worth half what they cost. As a rule, they do not contain more than 4 per cent. potash, so that $6 per ton is enough for them. There is about 40 per cent. lime in them, which, if your soil is sour, will sweeten it.

What is the best fertilizer for gardens?

Mr. Smith.—Good barn manure, with, perhaps, South-Carolina rock and nitrate of potash, would be best.

How should hen manure be treated and how used to get the most from it?

Mr. Cook.—Mix South-Carolina rock or land plaster. I prefer the former, because it contains phosphoric acid. The gypsum or land plaster in it will absorb and hold the nitrogen in the droppings. Road dust, if one cannot get anything better, does very well to dry the droppings, but I do not think it as good as the gypsum. Do not mix wood ashes with the droppings as the potash in them will drive out the nitrogen in the droppings. Broadcast and harrow them in.

Is salt beneficial to land, if so, in what quantities?

Prof. Cavanaugh.—Salt may be a benefit to a soil, although it contains no plant food. Its benefit consists in liberating plant food locked in the soil. The same is true of lime, plaster and perhaps some other substances. When we apply lime, plaster or salt, the potash may be liberated and thus made available for the use of the plant. When I was a student in college, we sometimes, when the oil got low in a lamp, poured in water. It raised the oil so that it came in contact with the wick and helped us out. But, after we use such substances a while, they seem to lose their effect. So far as the quantity of salt to be used is concerned, I could not advise. I do not think I would apply more than 400 or 500 pounds per acre, however.

Is muck of any value as a fertilizer, when in its original state?

Prof. Cavanaugh.—There is a difference in the value of muck. As a rule, its value consists mostly in its humus. Usually a muck soil is sour, and produces best results when lime or wood ashes have been applied to sweeten it.

To Mr Cook.—What is the best fertilizer for all crops?

Answer.—Good barn manure first, for any crop, but save it all. Use absorbents in the gutters behind the cows, to hold all the urine. Dissolved South-Carolina rock is the best, because it furnishes the gypsum, or what we know as land plaster, and furnishes phosphoric acid, beside.

Do you advise the using of any form of commercial fertilizer for corn, if you have barn manure enough?

Answer.—I think it pays to use a little nitrate of soda, say 50 pounds, mixed with 150 or 200 pounds of South-Carolina rock, about 200 pounds per acre, and apply it in the hill to give the plants a quick start. If one were using 400 or 500 pounds, it should be broadcasted, else the plants would be burned by the nitrate of soda. Use a small quantity, just to start the plants rapidly, putting the mixture in the corn hills.

What is plant food? How shall we cause our exhausted fields to become fertile?

Mr. Van Alstyne.—There are several elements of plant food, but there are but three that are of vital importance—nitrogen.

phosphoric acid and potash. A soil may be deficient in one or all of these elements, but one may tell which is most lacking. If the plant is feeble in growth and the foliage pale, nitrogen is needed; if the foliage is strong and the straw weak and falls down, there is too much nitrogen. If the plant fails to mature it lacks potash. If it does mature and does not mature seed or fruit, phosphoric acid is required. But a plant may mature satisfactorily in one field and farm and fail on another. And there may be latent plant food enough in the soil which humus and cultivation would set free. All plants take their food in liquid form, which to get, there must be moisture in the soil. As a rule, here, our soils are deficient in humus, or what is better known as vegetable mold. Barn manure and the plowing under of clover, rye, the Canada pea and the southern cow pea will furnish this humus most readily.

Would it pay to sow ammoniated fertilizers to increase the per cent. of spirit food in the soil?

Mr. Cook.—I don't know whether it would or not; as a rule, to buy commercial fertilizer in the market as they are sold, for the crops you and I grow, it will not pay. If, however, there is a deficiency of nitrogen in the soil, I would recommend some nitrate of soda, or dried blood or cotton-seed meal. There is not much difference between the price of the last two, which is not far from $20 per ton, while the nitrate will cost about $40. If phosphoric acid in the soil is required, I would recommend South-Carolina rock, instead of ground bone. The rock will contain from 12 to 14 per cent. of available phosphoric acid. As a rule, we have an abundance of potash in our soils, especially in our clay soils.

So, if I were going to buy plant food, I would buy the rock. If I wanted potash, except I were growing tobacco, I would buy muriate. Muriate contains some salt, sulphate does not. The muriate costs about $40 per ton, sulphate $10 more. Years ago our farmers used to buy land plaster, and they may now, but I would not draw it from the station if it were given me, because I can buy dissolved rock, get the phosphoric acid at market prices, and have the plaster free.

How can we get most value from manure?

Mr. Cook.—I don't know. It would depend on how the manure was kept, as a rule. According to the Cornell analysis, newly-made manures, urine included, is worth from $2 to $2.60 per ton. We have not been able, so far, to compost manure without loss; so we draw ours out every day it is made, and spread it where it will be wanted. There will be no loss, except it is washed off the ground. The potash and phosphoric acid cannot be evaporated, and, unless the manure heats up, there will be no loss of nitrogen. If one can save his manure so as not to have it heat, it may be most profitable to store it, but it will be found hard to do it.

What is the best method of keeping up and increasing fertility, and what crops do you recommend as best for the purpose, on farms run for all purposes?

Mr. Van Alstyne.—The first and best method of keeping up fertility will be found in keeping farm animals. Grow crops to feed the animals, then save and apply the manure from them. The best crop to raise is the manure crop; but it should all be saved. This means the liquids as well as the solids. Sixty per cent. of the value of the voidings is in the urine, and that is the portion that, as a rule, is usually lost. To-day, with the same number of cows I kept twenty years ago, I am making at least twice as much manure as I did then, while its value is fully doubled.

Years ago the cows were milked in the yard and allowed to run out, while the stable floors were leaky. To-day the floors are tight, with water-tight gutters behind the cows. Into these gutters we put horse manure, road dust, or land plaster, to absorb the urine. As a result, I manured well eight acres of land last fall from the manure removed from the gutters during the summer, which, under the old way, would have been dropped in the barnyard and not drawn out till the next year, when the urine would have all been lost and much of the nitrogen in the solids.

Would it be advisable to use hen manure as a fertilizer on land intended for strawberries?

Mr. Converse.—All the hen manure made on our farm goes on to the strawberries. There is no better manure. If, however, I wanted to make a "quick start" of the plants, I would apply a

little nitrate of soda, being careful not to allow any of it to come in contact with the leaves, else it will burn them.

Mr. Chapman.—One should be careful in applying nitrate of soda to strawberries. Do not apply too much, else it will so stimulate the plants that it will set too many blossoms which will develop a crop of small berries. Nitrate of soda, if it comes in contact with the leaves, however, will not injure them unless they are wet.

What is the mercantile value of a fertilizer containing 14 per cent. of acid phosphate soluble in water?

Mr. Cook.—That is no more or less than dissolved South-Carolina rock, which, I understand, is now worth about $14 per ton. I have several tons which I bought awhile ago for $11, but since then all fertilizer chemicals have gone up in price. The usual phosphoric acid has a tendency to set free potash in a certain degree in the soil, now unavailable.

How are we to get the manure on to our steep hillsides?

Mr. Cook.—If your buildings are below the hill I know of no way to get the manure on to the hills, except by drawing it there.

Would not the continued use of phosphoric acid tend to decrease that of nitrogen and potash in the soil?

Answer.—Possibly, but I would continue using it as long as benefits were derived.

Is it best to top-dress the meadows with manure from the stable or use it on cultivated ground?

Mr. Ward.—Put it out on the corn ground. What that crop does not take up, will be left for the oats or other grain crops that are to follow, or for the meadow later on.

Would you use plaster in your stables for an absorbent?

Mr. Cook.—No; I would not draw it home if it were given to me. It will absorb, but I prefer dissolved South-Carolina rock. There are about 280 pounds of phosphoric acid in a ton of it, and one-half of the remainder is pure plaster; so we get the plaster, practically free.

Mr. Dawley.—If you don't feel like using the "rock," use plaster or some absorbent by all means, the loss of liquid manure is one of the greatest leaks on our farms.

What is the value of a fertilizer, 14 per cent. acid, but only 12 per cent. soluble?

Mr. Cook.—I don't know. I told you what it costs, whether you can get your money out of it, is a question. But, no doubt, the ideal way to use it is in the stable as an absorbent. The phosphoric acid is an element in which, as a rule, barn manure is lacking. Twelve per cent. is worth a little less than the 14 per cent. fertilizer.

Where can South-Carolina rock be procured? What is the price? In what shape does it come, in bulk or in sacks?

Mr. Cook.—I have been told that the fertilizer men, or most of them, have formed a trust and refuse to sell chemicals to outside parties. Prof. Jordan of the Geneva Experiment Station, is looking up the names of these commercial fertilizer men who refuse to sell chemicals to farmers, and will publish their names in a bulletin. The price of South-Carolina rock has advanced somewhat recently. I think it is not far from $14 per ton.

Is there any difference in the phosphoric acid in ground bone, boneblack or South-Carolina rock?

Mr. Cook.—No; phosphoric acid is the same wherever found, but it may not be just as available in some forms as in others. The men who sell bone phosphate ask higher prices for it than do the dealers in the rock, because there is a little nitrogen in it, but the difference in the price of the two is too much. So, then, buy the rock.

Are not the fertilizer men refusing to sell chemicals to farmers for home mixing? If so, where is one going to obtain them?

Prof. Van Deman.—The German Kali Works do not sell fertilizers but potash salts and will sell to any one who wants potash, whether he be farmer or fertilizer manufacturer.

The professor mentioned other dealers who sell only chemicals or ingredients to any one ordering them.

What is the reason that land plaster does not produce as good effect on our land as it did forty or fifty years ago?

Mr. Van Alstyne.—Land plaster does not contain any plant food direct. It is largely sulphate of lime—its office being to develop moisture. The probabilities are that the soil being deficient in humus, it cannot develop moisture so that the soil can hold it. Years ago, when we saw an effect on soil, there was plenty of vegetable matter in it. Now, there is but little, hence it does not have the effect it did then.

How would you raise a selling crop from a field well supplied with plant food year after year without manure or fertilizer?

Mr. Van Alstyne.—If the field is well supplied with fertility there will be no need of adding any more. I know of no better way than to supply humus. There must be a deficiency of that, else there would be moisture enough without cultivation to grow a crop, provided the fertility in the soil were of the right distribution. If we have such fertility we must use the clovers or other green crops to supply vegetable matter. There is no such thing as an exhausted soil. Those which have been so catalogued have been found to contain an abundance of fertility. All that was needed was proper treatment. By adding a little potash and South-Carolina rock, and, perhaps, some nitrate of soda, to give the plant a start, with the humus and cultivation, such a soil may be brought up and good crops grown yearly.

What becomes of funds received from tax?

Prof. Jordan.—The revenue from these license fees is to be used in paying the expenses of inspection, including the salaries of chemists, the salary and traveling expenses of our traveling agents, the cost of gas and chemicals and the expense of printing the necessary bulletins.

What reason is there for taxing commercial fertilizers?

Prof. Jordan.—We adopt the license fee system in this State because it seems to be the only practicable way of adjusting the amounts of money available to the extent of inspection work to be done. We have simply put ourselves in line with all other States, with possibly one exception. Experience seems to indicate that this is the most satisfactory way of accomplishing the results. It is a large question and I will not argue it fully.

What is the tax on commercial fertilizers in New York? Does it increase cost to consumer?

Prof. Jordan.—The tax on commercial fertilizers in the State of New York will probably amount to about $10,000 for the year 1900. The rate is $20 per brand. As probably not less than 1,500,000 tons are sold in the State annually, the tax per ton is about two-thirds of one cent. I know from conversation with fertilizer men that they are utterly indifferent to the amount of this tax.

SILOES AND ENSILAGE.

What form of silo do you recommend?

Mr. Cook.—The round one. We have several square ones, but will build two round ones the coming summer.

Why do you prefer round to square ones?

Mr. Cook.—The round silo is more cheaply built, is as fully frost-proof, and there is not much loss of ensilage for the reason that there are no corners in which the ensilage can spoil by molding.

How will your siloes be constructed, and what will be the material?

Mr. Cook.—They will be round. The material will be pine. The staves will be six inches wide and three inches thick. They will be planed on both sides, brought to a uniform thickness, grooved and tongued on a bevel to fit the circle of the silo, put together with white lead and oil and hooped with five-eighths inch round iron. Such a form of silo is preferable to the square one, because, as I said, there are no corners in it where the ensilage can spoil, nor is the lateral pressure so great; but, if you are going to build a round silo, do not put a square roof on it. Have the roof round. It will not cost any more than does a square one, while its appearance will be much better.

Why not use the Page wire fence for hoops for a silo?

Mr. Cook.—I don't know. It is said that the fence makes good hoops, and some of our silo men are recommending it, but I am in doubt about it, so I shall use the round iron hoops.

Which is the better way to plant ensilage corn, in drills one way or in check rows in hills?

Mr. Cook.—We have practiced both ways. There is not much difference in results. When the ground is grassy, check rows are best. If not, I would plant in drills one way.

Mr. Converse.—I have never seen but one silo that was hooped with the Page fence. That was at Cornell, but it was not, in my opinion, keeping the ensilage just right.

Can a silo 24-feet deep be successfully filled with a two-horse tread-power?

Mr. Rogers.—I will say that, in my opinion, one would be losing money and time in trying to cut ensilage and elevate it twenty-four feet with a two-horse tread power. Use an engine instead.

What makes my ensilage spoil around the inside walls of the silo?

Mr. Cook.—Possibly the silo is not airtight and air gets in at the sides of it. Or it may be caused by improperly filling the silo. The ensilage should be kept highest on the outside, next the walls, and be well trodden. If it is kept highest in the center, when it settles there, it will draw away from the walls, thus allowing the air to get in. Keep the surface of the ensilage in concave shape, about like that of the inside of a saucer.

What about the stone silo?

Mr. Cook.—There is nothing about it, except that you don't want one. The first silo I ever saw was a stone one, and the next spring after it was filled the first time, one-half the ensilage in it was drawn out and thrown away. It was rotten and worthless. If you are going to build a silo make it of wood. It will not cost a fourth as much as will a stone one and the ensilage will not mold if it is in the proper stage when put in and is properly packed.

Is sorghum a good and profitable crop to raise for green feed and for ensilage? Where can the seed be obtained?

Mr. Cook.—The seed may be obtained of any of the large seed dealers or of the western growers, but I would not plant it. It was experimented with considerably some years since, in various parts of the State, but it was abandoned, it having been found that corn was much better for a soiling or ensilage crop.

Will it improve the value of ensilage to allow the corn to wilt, a day or two, before cutting it into the silo?

Prof. Cavanaugh.—Are there any farmers here who have tried the plan?

A Farmer.—I have. I allow it to lie and wilt a little, then cut it into the silo. It was a success.

Mr. Litchard.—Such a plan is all right unless a rain falls, and if there are no yellow leaves in the corn; but, if a rain falls while the corn is lying in bundles, it will surely injure it. What is wanted in corn ensilage is succulence. So, if we allow the corn to wilt or dry, we lose much of that element.

Would you advise the treading of ensilage, solid or not, in a silo?

Mr. Cook.—Ensilage needs only a reasonable amount of pressure, and it should be evenly distributed. As a rule, the heavier portion falls directly under the carrier, so that it should be carefully spread over the entire surface. If the silo is tight, when the ensilage is well spread, but little treading is needed. But one may tread it too much.

Does ensilage injure the flavor of milk? Will it impart bad flavor to it?

Mr. Cook.—If the ensilage is not well grown and preserved, I will say yes. Or, if the silo is not tight, thus allowing the ensilage to mold, the same result will ensue. But when the conditions are all right the only flavor which ensilage will impart is a good one.

Have you ever heard of an authentic case like the following clipping: "J. B. Bristol of Westfield, has just lost two valuable horses. The cause of their death is supposed to be due to eating ensilage. Mr. Bristol has a silo which he fills each year with green cornstalks, which are cut and made into ensilage. He fed some to his horses with fatal results. One was sick only a few hours; the other was sick four days. He valued the team at $300."

Mr. Cook.—I remember back, eight or ten years ago, in the early days of ensilage feeding, when it was reported that several horses near Rhinebeck had died from eating ensilage. I have never heard of a case of this kind since, until I read this.

Mr. Moore.—One of my neighbors lost a horse from eating ensilage, but he fed him so much that it caused colic.

Is it of advantage to feed beets with ensilage?

Mr. Chapman.—I have fed both beets and ensilage, two winters. Have concluded it does not pay to grow beets when I have ensilage.

Counting the expense of silo construction and filling, which is the cheaper and of most feeding value—ensilage or corn-stalks?

Mr. Ward.—The most expensive way to save a corn crop is to cut, shock and husk it. We once made the experiment and found that it costs $2.08 per acre more to harvest it that way than when put into the silo. Then, when it came to comparing the two, the old way did not compare at all with the ensilage. I think the feeding loss will be about thirty to forty per cent. in the old way, while not more than two to five per cent. will occur in ensilage.

What is the cause of ensilage molding about 18 inches deep from the outside, and the inside being good?

Mr. Converse.—I never have seen such a condition except when the stalks were too dry when put into the silo. Such corn ought to be wet down somewhat when cut, to hasten fermentation.

Why does ensilage mold in spots in the silo?

Mr. Ward.—It is on account of uneven treading. There would be no moldy ensilage if the treading were evenly and thoroughly done.

Why make ensilage, if the corn stalks have a food value of 1.013 and ensilage only .349, according to the chart?

Mr. Converse.—An acre of corn stalks will not weigh to exceed five tons, while an acre of ensilage will weigh from ten to twenty tons. It is not the question of per centages, but of weight that must be considered, also that of succulence.

How much corn ensilage should we feed a cow?

Mr. Cook.—From thirty to fifty pounds. We have even fed more than that, but I have come to believe it not best to feed too much of it, and I find by experiment that a little loose coarse fodder or dry hay is better when fed in ensilage. We also get a better flow of milk when the cows are on pasture if they are fed a little hay daily.

Will the feeding of ensilage cause tuberculosis?

Mr. Cook.—Now, if that man had put in: "will it injure the teeth and kill the cow," we would have a little longer text. No; ensilage made from good corn and put up properly will never injure a cow, but a whole lot of them are injured because of a want of it. We had a cow sixteen years old which we fed all the ensilage she would eat, but she thrived wonderfully on it. We have been feeding it fourteen years, and are more fully impressed of its value every year; and we find upon inquiry, that our experience is the general verdict of almost all farmers when asked to give their opinions.

Will calves fat well for veal when the cows are fed ensilage? If not, why not?

Mr. Cook.—I don't know why ensilage milk should not be just as good for calves as for any other use. Of course, they should not be fed ensilage alone. There should be some protein grains with it.

At what stage of ripeness should corn be cut for ensilage, and how long a time may one be in filling a silo?

Mr. Ward.—Cut the corn just as it enters the glazing stage. It is then at its best. You may, if you can, cut the corn and put it all in directly from the field, in one day, or you may be several days about it. It will not injure the corn if it is allowed to wilt and dry a little, so you may have intervals of a day or two; but at that season the corn will be ripening rapidly and the stalks losing in feeding value; so I would hurry the corn into the silo as rapidly as possible.

What variety is best for ensilage?

Mr. Ward.—The one that will mature the earliest and produce the most on an acre on your farm.. With us the large dent varieties are preferred to the flint sorts. As a rule, we grow for ensilage, "Pride of the North" or "Leaming." There are some other dent sorts that are also good for the purpose.

Mr. Cook.—"Pride of the North" is a good variety for ensilage when you get it pure. But the trouble is there are numbers of

bogus varieties sold for it. I bought some at one time which was not "Pride of the North," at all. Some dealers sell any variety that has a dent in it for "Pride of the North."

With us, in Lewis county, we find "Leaming" the best for ensilage. We want the variety that will produce the largest crop and mature it in our latitude.

Mr. Chapman.—"Huron's Dent," a variety that originated in Ohio, is being planted largely in Tompkins county, ripening in about ninety-five days there; but it does not produce as many tons on an acre as do some of the larger dent sorts.

Has the feeding of ensilage anything to do with tuberculosis in cows?

Mr. Van Alstyne.—Not any more than has the feeding of any other food, except, that if a man fed it to cows, then turned them out of doors all day long in winter and exposed them to cold weather, they might catch a cold, which, possibly, might develop into tuberculosis. There were more chances for catching cold here, last evening, and thus causing tuberculosis among some of us, than for a cow to get the disease from eating ensilage. Tuberculosis is nothing more or less than what we know as consumption, and has been growing less during the last twenty-five years, there being more than 10 per cent. less in our cattle and 20 per cent. less in the human family in that time.

Has Mr. Cook had any experience with octagon siloes?

Answer.—No, sir; but there is a gentleman present who has.

The Gentleman.—It costs a little more to build an octagon silo than it does a round one; but once built, one does not have to watch it or repair hoops. No tarred paper is used. I have three of them, made of two by six stuff. They have been in use three years; would not build any other form for myself.

Is it best to cut down the ensilage or feed from the whole surface?

Mr. Litchard.—It would depend on how large the silo was, or how much ensilage is being fed. As a rule, it is better to feed from the whole surface, enough each day to prevent the ensilage from spoiling.

Do you partly cure the corn before putting it into the silo, or cut it directly into it?

Mr. Terry.—It would depend on circumstances and conditions. We have had as fine ensilage from corn partly cured as from that cut into the silo directly from the field. As a rule, the greater portion of the evaporation comes from the leaves of the corn which contain but little feeding value.

In what manner does ensilage injure milk? Dr. Jordan, please answer?

Dr. Jordan.—It would depend. I am convinced, however, that good ensilage will not injure any milk. We have made cheese from milk from ensilage-fed cows that, within a year, scored 100 points. But there may be poor ensilage, which would injure milk, butter or cheese.

Mr. Dawley.—The four highest scores of butter at the Dairymen's convention at Cortland, last week, were made from milk from cows fed ensilage.

Mr. Cook.—We are now shipping milk to New York made from cows fed on ensilage, and we never had better milk. But there are many farmers who have, and are now, putting in unripened ensilage and in improperly constructed siloes, which cause trouble. The condenseries refuse their milk because of their neglect. When this objection has been overcome, there will be no further objection, and milk from ensilage will not be refused.

Is it cheaper to build one large silo or two small ones?

Mr. Ward.—It would depend. If one has not stock to eat the ensilage rapidly enough, it is better to have two small ones. In that case not so much surface will be exposed to the air.

Which is the best, to shred ensilage or cut it off square?

Mr. Ward.—All things considered, I think that ensilage cut square and short is preferable to that which is shredded.

A Farmer.—I prefer the shredded, two to one.

Would a silo built of the same material as water tanks—iron or steel—be as good as wood?

Mr. Cook.—The trouble with steel, iron or stone is, they are conductors of heat and frost. We want one built of something

that is a non-conductor. Siloes have been built of steel, but I have never seen them, and there have been but few built. I think that wood is the only material to use.

Does sweet corn make better ensilage than other varieties of corn?

Mr. Litchard.—I do not think it makes as good. Would rather have the common yellow corn than any variety of sweet corn for ensilage. It looks nice and tastes sweet on the table, but the cow says she prefers some other variety.

What causes white mold in ensilage?

Mr. Litchard.—There are three or four causes. As a rule, it is caused by the corn being too ripe when put in the silo. Such corn, unless it is well wet down, will mold. It may also be caused by too much moisture; then, again, by not feeding it rapidly enough, too much of it being exposed to the air.

What is the feeding value of ensilage as compared with $10 hay?

Mr. Litchard.—There is a difference in ensilage, just as there is in hay. As a rule, good ensilage as compared with good timothy hay, two and one-half tons of the ensilage is worth one ton of hay.

Is there a better way to use corn than in the silo?

Mr. Litchard.—I know of no better way. We have been, during the last four or five years, husking our surplus corn, and we find one ton put in the silo worth at least three tons cured and fed in the old way.

A Farmer.—Do you mean to say that you would feed this ensilage in the summer?

Mr. Litchard.—Certainly; there is no time in the year when ensilage is worth so much as in the summer, when the pastures are short. Next summer I am going to have a silo holding 75 to 100 tons, filled especially for summer feeding. I have learned that I cannot go through these summer drouths without it. The value of the silo is just as much of an established fact as is the river St. Lawrence and no one knowing anything about it will dispute the statement.

Why should corn in a silo spoil on two sides next to the boards?

Dr. Smead.—Doubtless the silo was not tight on those two sides, and so allowed the air to get in; or else the ensilage was not tramped enough.

Mr. Litchard.—Possibly the silo is not deep enough or the corn was too green or too ripe. We cannot take out anything from a silo we do not put in, any more than one of these ladies can take out something from a fruit can she did not put in. If she puts in unripe, over-ripe or wormy, half-grown fruit, she will take it out when she opens that can.

Would it be advisable to use Page fence as hoops for siloes?

Mr. Gould.—I would not use anything else. It costs less, and less for bolts than for wire hoops, and pulls the staves together so that you can't see between them in August any better than in December, while it costs but $6, against $20 for round hoops for a silo.

Mr. Woodward: The Page fence people advise me that they are making a special fence for siloes, that costs less than ordinary fence.

Does it pay to cut or shred corn stalks?

Mr. Van Alstyne.—Yes; more good can be got out of shredded or cut stalks than whole ones; but neither of these can take the place of good ensilage.

Do you advise building a silo in the barn?

Mr. Cook.—If one has a barn large enough, so that the room for a silo can be spared, he may build a silo in it. There will be some saving in cost, because at least one side of it will have already been built. Then, too, no roof will have to be put on. But one may build one outside, and we have found that no loss from freezing the ensilage, if it is allowed to thaw without being exposed to the air, will ensue. If the frozen ensilage is raked into the center of the silo and the hot ensilage there mixed with it, no loss will be experienced.

Why do some first-class condenseries reject milk from ensilage-fed cows?

Mr. Cook.—The Borden people first interdicted ensilage years ago, because there was much sour ensilage put up. But I have

found good authority for saying that fully as good milk can be made from good ensilage as from any other food, and it is being made from such ensilage all over the country. The St. Johnsville Condensery receives ensilage milk and says it is their standard for good milk. There are also creameries in the west which accept such milk and want more of it.

A Farmer.—I have a silo, but have no trouble in making good milk from my ensilage.

Is the round silo preferable to the square one?

Mr. Van Alstyne.—Yes and no. The round silo has no corners, which is a benefit if outside the barn; if, on the inside, build it square, because it can be built more cheaply there. It is a question of economy and the place it will occupy. My siloes are all square, but if I were going to build another outside it would be a round one.

Can we avoid a bad odor in ensilage?

Mr. Van Alstyne.—Certainly. When the corn is put into the silo, when in the glazing stage and is well tramped, there will be no odor from it. Last year a gentleman visiting me asked where my silo was. I said: "Step back about six feet and you will be in it." It is the immature corn that causes odors from ensilage.

What particular form of silo has given the best satisfaction—round, square, octagon or parallelogram?

Mr. Ward.—If one does not care so much about the cost I would recommend an octagon silo. But, barring that item, I would build a round one.

At what stage of ripeness should corn be cut into the silo?

Mr. Converse.—I would cut it at its greatest feeding value, which is at the time it enters the glazing stage. Fifty-five per cent. of the value of the plant is in the stalk, and sixty per cent. of that value is below where the ear grew.

Is ensilage in any way injurious to live-stock?

Mr. Converse.—No, sir, provided it is good ensilage and is properly fed. But it should be balanced with nitrogenous grains.

Mr. Ward.—There are 100 of them within five miles of me—all very much alike, and I have never heard a word of complaint about ensilage injuring animals.

How large would a silo have to be to hold 75 or 100 tons of ensilage?

Mr. Cook.—The weight of ensilage will depend on two conditions—the depth of the silo and the fineness of the cut ensilage. A silo sixteen feet in diameter and twenty-five feet deep, if filled to the depth of twenty feet of settled ensilage, will contain about eighty tons.

Mr. Ward.—How many of you here have siloes?

Just four hands were raised.

Mr. Ward.—Only four farmers in this audience who have siloes, and this the best part of Livingston county! I guess I will stop talking about the silo and talk about a cock or dog fight.

A Farmer.—Don't do that; keep right along. We did not have any siloes here four years ago.

Mr. Cook.—That is a very good record; one silo a year.

Mr. Ward.—We have more than 100 round silos within five miles of Batavia, one-half of them having been built within the last five years, and the number is constantly increasing. In fact, I do not know of but one man who has abandoned his silo in all that number.

Will sweet corn that has had the ears snapped off make good ensilage?

Mr. Ward.—No. I would not use sweet corn for ensilage. Some of our farmers who patronize a canning factory put the stalks into their siloes, but, as a rule, they are too tough and are not nearly so valuable as some of the dent sorts for ensilage.

What is the cost of a silo such as was described this morning?

Mr. Ward.—Not counting the work of setting up, which was done by myself and hired help, our silo, holding 75 to 80 tons cost $48.60. It would cost more now on account of the higher price of lumber and hoop iron. Ours is of hemlock, and after having been filled seven or eight years, is as sound as it was when it was first built. But ours is inside the barn. There is danger, however, that a round silo outside the barn will blow over. If I were to build one outside I would put a cover around and over it.

Is ensilage a good food for horses?

Mr. Ward.—We have fed ensilage to horses in limited quantities. Would not feed it alone. We feed it once a day.

Would you borrow money with which to pay for building a silo? Would it pay?

Mr. Ward.—If I had live-stock, I would build a silo. If I did not have the money, I would borrow it. If it burned up the next year, I would have had my money back.

Would you hill ensilage corn or drill it in?

Mr. Cook.—I don't think it would make much difference whether the corn is planted in hills—that is, check-rows— or in drills. The ground may be better cultivated when in check-rows. If the land is full of quack, check-rows are the best, because the ground can be more evenly reached with the weeder and cultivator. But, if the ground is free from foul stuff, probably best results will come from planting in drills, one kernel about every eight inches, and the rows about three feet, two inches apart. If every seed should grow, about ten quarts to the acre would be enough; but it will not; therefore, we plant a bushel of seed on every two acres.

Can good butter or cheese be made from milk from cows fed on ensilage?

Mr. Smith.—Yes. I made butter from milk from cows fed ensilage, which scored 100 points at the State fair. Of course we did not compete for a premium. The cows had no pasture at all, but were fed entirely on alfalfa and ensilage, with daily grain rations.

Dr. Smead.—Speaking of ensilage, I will say that at the Clifton Springs Sanitarium farm, 180 cows are kept on 180 acres of land, and ensilage is fed every day in the year. There are 480 patients in the institution, and all eat the butter made from the cows and drink their milk. If there was anything wrong about the milk, ensilage would soon be rejected. The superintendent told me that he was going to try to keep 200 cows on those 180 acres next year.

At what length would you cut ensilage? Is it best to shred it?

Mr. Converse.—We have tried various lengths, from half an inch to two inches. Half an inch we think best. It spreads more evenly and compactly than does that cut longer. Shredded ensilage has no particular advantage over that which is cut off short, while the cost is more because of an increased price of motive power.

If you were feeding ensilage once a day and timothy hay twice a day, what grains would you feed to balance the ration?

Mr. Smith.—Both foods are carbonaceous. We should always consider cost. I would try protein foods—wheat, bran, gluten, dried brewers' grains or malt sprouts. These are protein foods, which should be added to the others, to make a balanced ration. Send to Geneva, and get the bulletins which treat on these feeding questions.

What effect would bean meal have on ensilage?

Mr. Gould.—While in Maine I was told that bean meal, up to two or three pounds per day, make a good ration for milch cows.

Mr. Eastman.—In feeding bean meal alone with ensilage, the cows are liable to scour; we want some bran with it.

Some factorymen claim that if every dairyman fed ensilage, a good article of butter and cheese could not be made. Is the statement true?

Mr. Cook.—Not with us; I can make as good butter or cheese, if not better, from ensilage properly balanced than from any other foods; and that is the verdict of all our best creameries or cheese factories in the State.

J. F. Converse.—If ensilage is what it should be, it is just as wholesome and as healthful as any clover ever cut; but, there is now and then a farmer who feeds moldy ensilage which effects the milk, and there are some men who have abandoned their siloes because they were not properly constructed or the corn was not properly grown or ensiloed; but the masses who grow and feed ensilage are not abandoning their siloes or ensilage; on the contrary, the number of siloes hereabout is increasing each year. The prejudice is more against those who feed ensilage than against the ensilage.

Can a poor man, with a mortgage on his farm, afford to build a silo?

Mr. Rogers of Binghamton.—It is the poor man who cannot afford to do without it. He can keep his cows more cheaply than on any other starchy foods, while the quality of the milk from the cows, when the ensilage is properly made and put up, properly balanced and fed, is the very best. No! The poor man should be the first to build the silo. The rich farmer can get along without it, but the poor man, if he reaps any profits from the cows, must have it, if he wishes to lift that mortgage.

To Mr. Cook.—Do you recommend the Page fence as hoops for round siloes?

Mr. Cook.—Has anyone here had any experience with it?

No answer.

Mr. Cook.—I don't know. I have seen siloes hooped with Page fence. Will build two round siloes next season. Will not use the fence. Am in doubt. Have been reported as saying that I would use it. I have never said any such thing, because I know nothing about the practicability of the fence, for the purpose.

Mr. Smallwood.—No Page wire fence for my silo. I patronize home men. We have one right here in Warsaw who makes round iron hoops and fits them, ready for the silo. They are good enough for me.

Is it possible to produce as good milk from ensilage as from roots and grain?

Mr. Olin.—I prefer the ensilage, although I have fed both. I have found, also, that the roots and the ensilage work very well together. I fed both, all last winter, and obtained satisfactory results.

Mr. Cook.—The fault that once came from ensilage was caused by putting up the corn when not properly matured. But we hear but little of that now. It is one of the best cattle foods; but there should be some grain fed with it.

What is the manurial value of ensilage?

Mr. Cook.—It is very low, only about 82 cents per ton.

Would ensilage be a good food for sheep in summer, in place of pasture?

Mr. Cook.—Have any of the farmers here had any experience in feeding ensilage to sheep in summer?

No answer.

Mr. Cook.—I do not know anything about it, having never fed ensilage to sheep.

Mr. Talman.—I have not fed ensilage to sheep in summer, but I do not see why it could not be done. He also said that he had seen a flock of sheep that had been fed on ensilage alone during the winter and that they came out fat, only a tenth of corn meal was required to "finish them off" for market.

No one answered the question, but three or four farmers said they had fed ensilage to sheep in winter with highly satisfactory results.

What is ensilage feed valued at and its cost?

Mr. Cooper.—It would depend on the quality of the ensilage. It is worth from $2 to $3 per ton when the corn is fully matured.

Mr. Converse.—It may be raised for $1.50 per ton, depending, however, on circumstances—such as yield. I would use the largest variety of corn that will mature. My experience is that we can ripen any of the largest varieties of dent corn in 100 days. If we give proper cultivation, we may advance the ripening period of at least 10 days. Some farmers advise the raising of the larger flint varieties because they ripen earlier than do the dents. But as a rule, when the crop is put in early enough, and the proper cultivation given, we find no difficulty in maturing any of the dents such as "Pride of the North" or "Leaming."

Is it better to feed sowed corn in the dry stalk or feed in the form of ensilage, for making winter milk?

Mr. Ward.—I suppose that means sowed corn. I would never put sweet corn in that way. It were better to plant it in rows, three feet and a half apart. We use Stowell's Evergreen for that purpose, and plant about 14 quarts of seed per acre. If I had such sowed corn I would allow it to dry a little, then put it into the silo.

Could a man afford to borrow $100 to expend in building a silo?

Mr. Cook.—Yes; if he has a dairy that will consume the contents of such a silo. The interest on that sum would not be much, while the silo would enable him to keep two or three more cows. I believe it will pay one to borrow the money to build one.

When a man has a silo he will be surprised to see how much a cow will eat, and will begin feeding better. For one, I much prefer to have one cow well fed, than two half starved.

Will corn put into the silo whole keep in good condition?

Mr. Ward.—We had a neighbor who filled two siloes with uncut ensilage. The next year he took it all out and threw it away. I never have known of whole ensilage keeping well.

What can I best raise to put in my silo to feed during the drouth in summer?

Mr. Terry.—Corn. It is the best crop; but one must supplement it with some protein crop, such as wheat bran. One should have two siloes, one for summer the other for winter feeding.

Mr. Cook.—Have two siloes—and do not make the mistake of making them too large, because we ought to feed off enough from the surface to prevent the molding of the ensilage. Next summer we will build two additional siloes, one to be filled with corn for summer feeding, as I am satisfied the cows suffer more for the want of proper food in summer than in winter, and summer ensilage will supply the want, in great part.

How do peas and oats compare with corn as a soiling crop?

Mr. Cook.—We prefer the peas and oats, for the reason that they contain more protein than does the corn. But one should have both; one to balance the other. Still, when corn is well grown and preserved in the form of ensilage, it seems to knock out, somewhat, the objection that it is not a milk-producing food.

Which do you recommend for a summer soiling crop, newly mown alfalfa or good corn ensilage?

Mr. Converse.—We have had considerable experience in feeding alfalfa and ensilage as soiling crops. We prefer the latter for the reason of the expense attending the going into the field every day and cutting alfalfa. At our cheese factory, and another one a mile away, last summer, only eleven patrons out of seventy-one had anything to tide their cows over the drouth. It is one of the gravest and most costly mistakes the average farmer makes—this neglect to provide some soiling crop for the cows when the annual drouth comes on. Beside that, when we have ensilage, we can

keep the cows indoors during the severe hot weather in fly time and let them out during the night.

Mr. Smith.—At the State farm, Geneva, we resort to alfalfa and ensilage. The very best results come from both. Last year we fed ensilage during the summer and got fully as good results from it as from alfalfa. If you are going to count the cost of the two crops, together with the expense and convenience, as between the two, we prefer the ensilage for summer feeding. By this I mean green alfalfa. We cut it in the morning, when the dew is on, then allow it to dry and wilt. It is then drawn to the barn and fed. No cases of bloat have ever occurred. About a basketful of alfalfa is fed twice a day to each cow.

THE CLOVERS—THEIR VARIETIES AND USES.

To Mr. Terry.—At what stage of growth should clover be plowed under?

Answer.—It is not safe to plow under any green crop if too heavy, because there is a tendency to create acid in the soil, and I should not plow under a green crop of clover. Cut the first crop for hay, and leave the second crop on the ground to be plowed under in the spring, for potatoes or corn. During the last three years, we have made two to three cuttings of clover each season, and fed it to our cows. If I were going to plow under a green crop it would be "cow peas." They are nitrogen catchers, and will, besides, furnish humus for the soil. The variety known as "Whipporwill," is the best of the cow pea variety.

Mr. Cook.—With the dairy farmer, two things must be considered when contemplating a crop—first, its feeding value; second, its fertilizing. When we come to this, if we grow it, clover for the protein ration, is the best. Its nitrogenous value is the greatest of any of our grasses while its fertilizing value is fully as great.

Is not timothy a better fodder crop than clover?

Mr. Converse.—No, sir; it is not. I would rather have one ton of clover than two of timothy for any animal except horses kept for speed. But, clover should be cut as early as June 25th, then the second crop may be cut early, and saved in the form of "rouen." In this way we get the feed value of both crops.

A Farmer.—All the improvement in Allegany county which has come to it within the last 30 years has come, in my opinion, from timothy. Why do men buy timothy instead of clover? Years ago, there was a tavern every mile on our public roads in this county, and about all the products were leeks and whiskey, and the buildings were poor. Now they are all good, and the difference is due to timothy.

If a crop of timothy is cut early and not pastured, is it more exhausting than is clover?

Mr. Converse.—Yes, sir. We all know that the legumes take nitrogen from the air and restore, or give it to the soil. The clovers are of this class of plants. Timothy does not absorb nitrogen from the air, but, on the other hand, takes it from the soil. For this reason we do not grow timothy at all. We do not mow clover but once, but plow under the second crop.

How can we get a good crop of clover on hard pan soil?

Mr. Converse.—Our soil is a clay loam. We have changed from seeding with clover on a spring crop or with winter wheat. We now sow oats and peas on the land we want to seed. When the crop is off we harrow the ground and fit it thoroughly; then sow the clover seed about the first of August. As a rule, the next year's crop of clover will be as heavy as will that sown in the spring, even when we get a good catch.

Mr. Moulton.—The trouble with hard-pan land is, it is not plowed deeply enough, so that the water comes up and stands in the soil too closely to the surface. Plow the land deeply and fit it finely so that it will not "heave" in the spring. By following this plan on a stiff, hard-pan soil, I do not believe there will be any trouble in obtaining a catch of clover, even when sown with spring crops.

What is your opinion about sowing red clover and cutting it one year, then plowing under for humus?

Mr. Van Alstyne.—If I wanted to grow a spring crop, I would plow under the second crop in the spring. If I wanted to grow a winter crop, I would plow it under in the fall, but would cut and save for hay, the first crop.

What is the difference between mammoth and pea vine clover?

Mr. Converse.—I suppose what is meant by the queston is the medium or mammoth variety. If so, I will say that I prefer the medium to the mammoth, as it does not fall down so easily. Besides, finer in stalk and is eaten more closely by the cattle than is the larger variety.

Mr. Cook.—We sow both mammoth and medium on our land. I prefer the former. We sow at least three bushels of it to one of the medium.

Has anyone here had any experience in pasturing with alfalfa?

Mr. Cook.—Alfalfa is being sown with success in many places. It should be sown thickly so as to have a thick growth. The soil should be deep, dry, well fitted, and the plant given the entire use of the ground. The next season, from two to four cuttings may be made. As to pasturing it, I will say that it may be done, but there is danger of the animals' eating the plants so closely as to injure the crowns. It is much better to mow and cure it for hay; but it should be cut early, else it will become woody. It should be cut the first time as early as June 6th to the 20th, and again in July. When the seed is allowed to mature, the plant is about worthless for hay. As many as four cuttings were made at the Geneva Experiment Station, the soil being a deep clay loam, well underdrained. There were more than 16 tons of green hay in the four cuttings. If you will go to Geneva next summer you will see the field and will be able to obtain full information concerning it. I also think there has been a bulletin issued at the station giving some results with it, but that was three or four years ago.

Who grows it here?

A Farmer.—I have, but it has been a failure with me. Practically it was all gone in two years. It is not as good as the clover here.

Mr. Cook.—Have well prepared land and have it dry; then sow 30 pounds of seed per acre and give it the whole use of the land. The critical period is its first winter. If it survives that, there will not be any further trouble. I would try a small piece of it to begin with. If you succeed with it, sow more.

Mr. Litchard.—Years ago I tried it. Won't say anything about it now.

A Farmer.—Over on the river flats, a man has three or four acres. He reports satisfactory results.

Mr. Hardy.—I have a small piece of it. It is satisfactory, but we found when plowing the ground roots five feet long, and the plow might as well have run against a stump.

Mr. Dawley.—That came from not sowing the seed thickly enough. When 30 pounds of seed are sown, the spears are much finer, but the cutting should be done before the seed is formed, else the plant will become hard, woody and entirely worthless. Sow it at the time the spring grains are put in, and when the plants and weeds are a foot high, run the mower over, and cut everything down to within four to six inches of the ground, and leave it for a mulch, unless there is too much of it. In that case rake it up and draw it off. The next season, if it withstands the first winter, there may be two or three more cuttings made. We have cut ours three times, but as a rule we make but two. We have a field of it that has been growing 10 years, and the stand seems to be as good as ever.

If you are to grow it, either have the soil well underdrained, or else put it in good soil, naturally dry. Alfalfa will not grow on wet land, although it requires moisture. It is a very deep rooter. The roots go down, if they have the opportunity, several feet. Last summer, about all the green thing on our farm was the alfalfa. Professor Voorhees, of New Jersey, says he grew on the station farm there an equivalent of $125 per acre of protein in an alfalfa crop. It has about the same power, possibly a little more, of taking nitrogen from the atmosphere and giving it up to the soil as have the red clovers.

Would you advise seeding to grass or clover with the corn?

Mr. Litchard.—I have never tried the experiment, but I know of its being done in Chautauqua county and it is said, quite satisfactorily. We have, sometimes, sown clover with our corn. I have ten acres that have never had a load of barn manure or a spoonful of phosphates on them, that are now producing good crops. They have been kept fertile by the use of clover and cultivation. We take off, first, a crop of clover, and follow that with

either potatoes first and then corn, or corn and then potatoes. We always plow under the second crop of clover. As a rule, I use winter wheat for a seeding crop.

Which food is the richer in protein, clover or bran?

Mr. Cook.—Bran is the richer in protein of the two. It has a ratio of 1 to 4; clover has 1 to 5 or 6.

To Mr. Smith.—What kind of soil does alfalfa require?

Answer.—Alfalfa needs a deep, rich soil, free from water. You could not go down on to this flat and grow alfalfa. Have the ground rich and made fine by cultivation, and the subsoil broken up so that the roots can go down. And it is a good plan to nourish the young plants with a top-dressing of good, fine manure. Sow 30 pounds of seed per acre.

Do you favor the seeding with clover in August, after oats?

Mr. Cook.—We sow the clover seed on winter wheat in the spring. Seeding after oats in August is recommended and is practiced by some farmers. I prefer spring seeding, however, on our farms in Lewis county.

What grains are best for a seeding crop with clover?

Mr. Eastman.—Spring wheat first, winter wheat second, barley third.

Mr. Cook.—After all, is it not a question of moisture? So I would not seed with oats; they take out nearly all the moisture from the soil, thus robbing the clover; consequently it dies.

How is rape as a fertilizer plowed under?

Mr. Gould.—Analyses show rape to be half as rich in nitrogen as is clover.

How can we get our clover seed to catch in a dry season?

Mr. Eastman.—By putting the clover seed in in the best manner possible. The ground should be properly fitted and fined, the grain drilled in, then fallowed with the smoothing harrow, then with seeder, which puts the seed in at shallow depth. The trouble is, the clover seed, as a rule, is put in too deeply. Where

is the lady who does not fine her flower seed bed with a rake before sowing the seed? Surely, there is no more vitality in clover than flower seeds.

What variety of alfalfa is best? How much seed should be sown per acre, and how should it be sown?

Mr. Smith.—I know of but one variety of alfalfa. It has a small, purple blossom. We have eight acres of it at the station farm at Geneva, and feed 25 cattle from it.

Will the feeding of alfalfa cause "bloat"?

Mr. Smith.—Yes. So will the feeding of too much clover. Alfalfa, in fact, is one of the clovers.

When do you cut it?

Mr. Smith.—Just before the blossom forms. If left till a later date it will become hard and woody.

Do you grow crimson clover on the State farm?

Mr. Smith.—Yes. We grow it in the orchards. Last year it was a beautiful sight when in blossom, about the middle of May. We sow the crimson clover and winter vetch about the first of August, as a cover crop, on our plowed land.

What about the vetches? How many varieties are there?

Mr. Smith.—I do not know. The vetch belongs to the pea family—is therefore a legume—and has the power of gathering nitrogen from the atmosphere. Crimson clover has the same power, and an additional value because it grows at a very low temperature, therefore, very late in the fall. We grow it as a cover crop—to plow under in the spring—not for hay, nor for pasture.

How shall we grow clover on some farms where we cannot get a catch?

Mr. Smith.—There are two causes: An acid oil, or want of humus. Test the soil with blue litmus paper. If there is acid in the soil the color of the paper will change to red. An application of lime will sweeten it. If the cause is a lack of humus, the plowing under of rye or barn manure will furnish it. There must be humus present to hold moisture, to unlock plant food

which is unavailable. Wood ashes may be applied in place of the lime. They contain about 60 per cent. of lime, four to five per cent. of potash, and one and a half per cent. of phosphoric acid; but the latter is very slowly available. Good, unleached hard-wood ashes ought to be worth from $6 to $7 per ton, depending upon locality and the cost of lime.

How early is it advisable to sow clover seed on winter grains?

A Farmer.—I sow it in March.

Mr. Cook.—We sow it on the sugar snow, say the first to the middle of April, sometimes a little later in the season.

Should alfalfa be sown in an orchard? Would it injure the trees?

Mr. Armstrong.—I have an uncle in the West where they grow a great deal of alfalfa, who sowed some in his orchard, but a number of his trees died, before he could plow up the alfalfa. He thought it rooted so deeply that it took all the moisture away from the roots of the trees.

A Farmer.—Will alfalfa grow on steep hillsides?

Another Farmer.—Not on yours. It would all slide off.

Mr. Smith.—It will grow if the soil is suitable.

Will Mr. Terry tell us how to raise the first crop of clover on poor land?

Mr. Terry.—I cannot answer that, but there may be circumstances where the farmer may help himself. Sometimes a soil is acid. If it is, clover will not grow. An application of 20 or 25 bushels of lime per acre, or of potash, will sweeten the soil. At other times a lack of humus prevents the soil from holding moisture, so the young clover plants, when the drouth comes, die out. Between the two—lime and potash—with the humus in the soil, as a rule, clover may be made to grow. I would not sow timothy except, possibly, in small quantities, say four quarts of seed per acre.

What would you do with the clover when grown?

Mr. Terry.—That would depend. Formerly, we plowed under the second growth of clover. We then kept no cows. Now we are keeping some, and so cut some of the second growth clover for them. We have built up a herd which gave 7,341 pounds of milk last year. One two-year-old heifer gave 6,000 pounds. We now

get $1.40 for 40 quarts, minus 15 cents per can, freight, delivered in Cleveland. We have ten cows.

Is alfalfa as good a crop as the common red clover varieties?

Mr. Terry.—I heard Prof. Voorhees say that they cut 20 tons of green alfalfa from one measured acre, containing 1,560 pounds of digestible protein, which is fully four times as much as can be obtained from an acre of the red clover varieties.

A Farmer.—Here about, alfalfa grows well enough on low ground, but it does not succeed on high land. In California, where irrigation is practical, it grows well; if we could do that here, no doubt it would grow. It roots very deeply—sometimes 40 to 50 feet.

Mr. Cook.—We have grown alfalfa a number of years, but it required much time to learn how to do it. An old Frenchman who worked for us, brought a package of seed from France, and showed us how to sow it; we now succeed, but we first put the ground in the best possible tilth—just like a garden—then we sow nearly a bushel to the acre, early in May. Once well established it withstands a drouth the best of any plant I know. Last year, about all the green thing in sight on our farms, in August, was the alfalfa. But I incline to the belief that upland is better than low land; and I should advise every farmer present to try a small piece of alfalfa by way of experiment; but do not pasture it, and do not sow the seed except in early spring.

What is the matter with the soil when clover has wintered, then does not grow when spring comes?

Mr. Van Alstyne.—I don't know as I can answer that question positively but my opinion is that the soil is acid. Clover must have nodules on its roots, to hold nitrogen, and these nodules will not live in an acid soil. The remedy for such a soil is an application of lime to correct the acidity by sweetening it. Apply 20 bushels per acre. I have just such a field. It grows any crop but clover, so I shall treat it with lime next season.

Mr. Cook.—My observation has been that, on lime-rock soil, clover grows well. In our county the soil is a lime rock and clover grows on it abundantly.

How is alfalfa clover as a substitute for corn for ensilage?

Mr. Cook.—It would not be any substitute, because it is a wholly different crop. Corn is a carbonaceous crop; alfalfa a nitrogenous one. But I should never put it into a silo. Corn is much better. If you can grow alfalfa, cut it early, cure it as hay, and feed it in connection with the corn ensilage. Sow it early, about the time the corn is planted.

To Mr. Van Alstyne.—Would crimson clover thrive in this locality (Schenevus)?

Answer.—Crimson clover is now being grown in the valley of the St. Lawrence river, but, if it is to succeed, one must get the seed grown as far north as possible. Southern-grown seed does not germinate well, or else produces a feeble, weak growth. Obtain seed from acclimated clover and sow it in the corn or potatoes to cover the ground, and to be plowed under the next spring; and be sure to put it in deeply, else it will sprout too quickly. If sown in the corn, run a narrow plank drag or stone boat over the ground to pack it tightly over the seed. Thus grown, one gets two crops on the same ground, and I am satisfied that, if the crimson clover now on my ground does not survive the March and April weather, it will be worth to me all it has cost.

A Farmer.—We do not always get a clover catch here (Springville). It failed two years ago. What are you going to do about that?

Mr. Converse.—I believe that on ordinary dry soil, if clover is not grown, it will be the fault of the man. Of course, there are some wet, mucky soils which are sour, that will not allow clover to grow on them. An application of lime or ashes will sweeten such soils, so that clover will thrive; on fairly good, sweet soils, if humus is present, so that moisture is retained, the clover seed will germinate and the plants grow. You may test the soil by inserting a small piece of blue litmus paper in it for a few minutes. If in that time the color changes to a dull red, you may know that acid is present. If so, apply a good dressing of lime or ashes.

What time of year is best for sowing clover or timothy seed?

Mr. Cook.—We sow our clover and timothy seed on our winter wheat, as a rule, from the first to the middle of April.

Is there any difficulty met here in getting a clover catch?

Mr. Harmon.—Years ago I had no difficulty in getting good catches of clover, but I have not had one in ten years. I believe it is because I have grown so many beans. My loss from failing to grow clover has been thousands of dollars, and I have been forced to resort to commercial fertilizers to replace it as far as I could.

Do we cover our clover seed deeply enough?

Mr. Cox.—I believe that we do not cover deeply enough. I think that is the main reason for our not getting better catches some times.

Does not potash always help the growth of clover?

Mr. Cook.—If there is potash enough in the soil, and it is available, an application of more would be of no avail. If that in the soil were not available, an application of potash would benefit the clover.

At what stage of growth should clover be cut?

Mr. Litchard.—When it is nicely in blossom. After that time it begins to deteriorate. The same is true of other grasses which we use for hay.

How much clover seed is best to sow on an acre?

A Farmer.—Eight quarts.

Another Farmer.—Sow six quarts of clover and two of timothy.

Mr. Cook.—We sow eight to ten quarts of clover and two to four of timothy.

Will clover or corn grown on thin land contain as much feeding value as will that grown on rich land?

A Farmer.—That is my question. I have heard it said that a ton of clover from poor land was not as good as one grown on good land, for feeding purposes.

Mr. Converse.—Dr. Jordan said at Geneva the other day, that they were experimenting along that line, with the view of finding if a plant will take out more from the soil than it needs, but that results will not be successfully reached until after a number of years.

OATS AND PEAS.

What variety of peas do you sow with oats, and how many per acre?

Mr. Converse.—The small white Canada pea. We aim to sow oats enough to hold up the peas, so that they will not fall down and mold. We sow one part of peas and two of oats.

Mr. Cook.—We have no fixed rule; but we aim to sow oats enough to hold up the peas; from three pecks to a bushel and a peck. The first sowing is wholly oats and peas; the later one has a little barley, sometimes half a bushel, mixed with it per acre.

At what stage of ripeness do you cut them, and for what purpose do you grow them?

Mr. Converse.—We cut them just as soon as they show a "yellow tinge," and do it with a mowing machine. They are then too green to be cut with a binder or one of the old "poke off" reapers. At that stage the grain has the most value, while the straw is fully as valuable for feeders as is timothy hay. We allow them to remain on the ground and cure like hay. We feed them for hay, or thresh and grind them. We also use them as a soiling crop, beginning the cutting of them when the first dry weather comes, which is usually about the first of July.

Is there any better grain to sow with peas than oats, to hold them up? What about sorghum?

Mr. Cook.—I do not know of any better grain than oats. Wheat might help out, as the straw is stiffer than that of oats. Sorghum would not do, it is too much like corn.

Mr. Dawley.—Oats and peas are the best crop we grow, except alfalfa, when fed as a soiling crop for hay or to thresh and feed as grain, especially when fed with ensilage. We use the small, white Canadian pea, the mixture with oats differing according to the richness of the land. But we manage to sow oats enough to hold up the peas. We must not allow them to mold. The ideal way is to plow under the peas about four inches, then a week later, sow the oats; but we have had most excellent results by sowing them together. It will depend on the season and condition.

Mr. Rice.—We had most excellent results by putting the peas in with a drill, setting the drill four inches deep, then cross

drilling in the oats the same day, at the ordinary depths. Both crops came up at the same time.

Mr. Cook.—We sow from a bushel and a peck to a bushel and a half of peas, and pretty nearly two bushels of oats, per acre, and it will be best to mix in a little barley in the last sowing. We make three sowings of oats and peas each season, at intervals of a week or ten days. The barley is mixed with the last one.

Give comparative feeding value of oats and peas.

Dr. Smead.—Oats have a nutritive ratio of one to seven, bran, one to three five-tenths. Their value would depend on the coarse food one had to feed. If he had a large quantity of straw or timothy hay, more protein should be fed. The best single food for a horse is oats; but if a horse is being worked hard and twelve quarts of oats and two of wheat bran are fed,—I don't care what the coarse foods are.

Are oats and peas as good as clover, and are they good to seed after?

Dr. Smead.—Clover fills a place in American agriculture that no other plant can. I hope therefore that what I am saying concerning oats and peas will not cause them to sow less clover; but as a succulent food to have to feed all animals during periods of summer drouth, oats and peas fill a place that clover cannot; also in seasons like that of 1899, when it becomes a matter of necessity for the New York State farmer to raise something for dry fodder, to carry his live stock through the winter, the oats and peas fill the bill in my experience better than anything else. They can be sown as soon as the frost is out of the ground in the spring, and as late in my section of the State as June 20th, and with even as dry a season as 1899 a fair crop of oats and pea hay can be made, providing the ground is made fairly rich and well tilled. I have cut as many as four tons of cured hay per acre, and never less than one, and that was last year when the extreme drouth made the yield short. As a grain crop for feeding, when sown one-fourth peas (always the small white Canada variety) and three-fourths oats, a feeding grain is produced which when ground is almost ideal for milk production, both in cows and ewes suckling lambs. For horses the peas in

the oats are far superior to corn of equal quantity; the nutritive ratio being, when sown in that mixture, a little over one to five, and when the coarse food is timothy hay, it makes a ration for work or driving horses as near perfect as can be. Occasionally a horse of a loose bowel temperament will be a little too much relaxed for road work, but ten horses are constipated where one is too loose. The peas can therefore be added with advantage in nine cases out of ten. The straw also from an oat and pea grain crop I consider equal to average timothy hay, if cut when the oat is in the dough state and the straw green. In cutting hay always cut before the oat gets to the dough state, just coming into the milk; harvest just as hay is cut, namely, with a mowing machine and rake up the same as hay, then all will be eaten without mussing over to get the heads of the oat when cut and cured in that way. The nutritive ratio is about one to eight when sown one-third peas and two-thirds oats, and all animals relish the hay and thrive upon it with but little grain of any kind. While I do not claim that oat and pea hay will equal fine early cut mixed grass hay, in my experience it comes the nearest to it of anything that can be raised on our farms. In a case of emergency or where there is likely to be a shortage in fodder, I have succeeded better in sowing clover or mixed grass seeds with early sown oats and peas than with oats alone, or with other spring crops. In conclusion I will say, sow oats and peas for a grain crop; sow oats and peas for hay when needed; sow oats and peas to cut green during drouth if you have no summer silo, and if it is sheep you are feeding in the barn, oats and peas are preferable to ensilage; then sow lots of clover to feed with your oats and pea straw that you raise for grain. The clover will enrich the soil so that more oats and peas can be raised, to raise more live-stock; produce more milk; more fat lambs; more wool; more good colts; that the farmers may have more money, have better homes and a whole lot of better things.

BEANS.

Have you ever dragged your beans?

Mr. Watson.—I have never harrowed them, but have used the weeder.

Is it proper to rake up beans with a horse rake?

Mr. Harmon.—I tried the experiment last year for the first time. It reduced the labor from one-third to one-half, but the hired help must be instructed thoroughly to shake the earth off them.

Ought beans to be cultivated when the vines are wet?

Mr. Wilson.—No.

A Farmer.—I would not cultivate beans when the dew was on, even. I would rather the hired man would sit on the fence and whittle a stick.

Shall we plow shallow or deeply for beans?

Mr. Wilson.—I prefer to plow deeply, then pulverize thoroughly.

A Farmer.—I think it better to plow more shallow. Our soil is gravelly, and if it is plowed deeply the moisture will go down below the reach of the roots.

Mr. Cook.—When plowing a clover sod I think it better to turn the furrows at an angle instead of bottom side up. If such furrows are rolled down, then well pulverized, they will hold moisture much better than will those turned over and left in a flat condition. Beans, if they "fill" well, must have moisture when the seeds are forming, and as we do not get enough from the usual rainfall it must be obtained by conserving it through cultivation.

Is bean straw a good food for horses or milch cows?

A Farmer.—Bean straw is all right for cows. Feed them only just what they will eat up cleanly. It is next to clover for cow feed.

Mr. Smallwood.—It is all right for horses. I have fed it to Percherons, but they will eat anything.

The Reporter.—The town of Ellisburgh, Jefferson county, produces more beans than does any other one town in the State. There are five wholesale dealers in beans and peas in the town who furnish hand-picked seed to the farmers of that and adjoining towns. The crops are grown on contracts. Two of these seedsmen put out last year 55 varieties of beans and 45 of peas each. There are 6,000 cows in the town, owned by 365 dairymen, nearly every one of whom feed "bean fodder" to their cows, and

all agree in saying that such fodder when properly secured is very good, an acre of it being worth fully as much as an acre of average corn stover. But to contain such feeding value the beans must be hand-pulled, cured and housed before the leaves have dried up and fallen off, else nothing but the stalks and stems will remain, thus reducing the value considerably. There is much value also in the pods when properly secured and fed in connection with other foods to dairy cows.

What is the best cover crop to follow beans?

A Farmer.—Winter rye.

Mr. Smallwood.—Many of us sow winter wheat after taking off the beans.

Another Farmer.—I usually sow winter wheat after beans; have taken off as high as 40 bushels per acre of wheat, which was sown on land from which a crop of beans were harvested the summer before.

Will land plaster help beans?

Several farmers said they had used land plaster on beans and were satisfied that good results had been obtained therefrom.

MILK AND ITS PRODUCTS.

When milk two days old is taken to the creamery, what is necessary to get a correct sample from it?

Mr. Cook.—As correct a sample may be obtained from milk two days old as from milk one day old. But I have seen milk that an accurate sample could not be obtained from, whether it was one or two days old. It was caused by some of the cream rising and hardening on the side of the can, so that the per cent. in the milk was lessened. Unless such milk is carefully cared for, correct sample cannot be obtained. Milk should be aërated as soon as drawn from the cow, but if new milk is to be mixed with milk of the day before, it should be cooled to that temperature before mixing both messes.

Should milk be stirred with a dipper?

Answer.—Yes; but the trouble is that it is not always attended to. It is better to use a cooler, than an occasional stirring

will answer. As a rule, when milk is poured into the weigh-can, it becomes very thoroughly mixed, so that a correct sample can be taken from it at any time it is running into the vat.

What is sterilized milk and what are its advantages?

Dr. Van Slyke.—The general principle is to put the milk in a vessel through which runs a steam pipe, which heats the milk up to 140 to 150 degrees. The milk is then immediately cooled down. This is pasteurizing. Sterilized milk is that which has been heated to a point which kills all germ life in it, but it sometimes gives the milk a "cooked" flavor.

Will milk containing 6 per cent. fat make twice as much cheese as will 3 per cent. milk?

Mr. Cook.—No. Above about 4½ per cent. milk the fat falls behind the casein, and so will not make as much cheese in proportion as will milk below that figure, for the reason there is not casein enough to hold the fat.

Is butter made from separator cream softer than that made from milk creamed in pans?

Mr. Cook.—No, when the butter is properly made. But cream when it comes from the separator should be at once chilled down to 50 degrees and held till the fat globules have hardened. If it is then warmed up to 60 degrees, ripened and churned, the butter will be as hard as that made from cream raised in pans. Milk goes through the separator at 80 degrees or higher, so that if the cream is not immediately cooled down, but is allowed to settle slowly to 60 degrees and there held and ripened, the fat globules will be soft. This fault was quite prevalent when the separator was first introduced, and people complained that the butter was soft, without grain and would not stand up as did that made from shallow pan or deep-setting cream. When, however, the cause was located and a remedy found there was no further trouble encountered.

A question as to whether the Babcock test was fair for determining the value and price of milk for making cheese, or whether it was fair to all the patrons of a cheese factory to declare dividends on the basis of the fat content of the milk, brought out considerable discussion, Mr. Cook saying that "the old pool sys-

tem at the factory was simply offering a premium on poor milk. If we are going to pay for all grades of milk alike, why should one strive to have better cows? Why not go out and buy a herd of cows that will give 50 or 60 pounds of milk each that only passes the State test? There is no incentive for a man to improve his herd, except to raise the milk flow, and the thinner the milk the better, provided it will stand the test. Just why so many factories in Allegany county should discard the Babcock test, and why there should be so much opposition to it, I do not understand."

Which is best, to sell our milk or to patronize the creamery?

Mr. Rogers.—It will depend on what you get back. The question is an indefinite one. If a man can utilize the skim-milk at a good profit, the creamery may be the best place. If not, the cheese factory or the shipping station may prove more desirable.

A Farmer.—I patronize the creamery, raising the cream at home. It is called for by a gatherer. Some of the patrons use the separator, others the Cooley system, but the cream is paid for on the Babcock test basis.

Mr. Cook.—We have shipping stations, creameries and cheese factories in our county, and I have noticed that the price of milk at the shipping stations is always based on the value of milk for butter and cheese. When the prices for these products go up, up goes the station's price for milk. When it drops, then down goes the station's price. But there is not enough milk consumed at home. Some farmers do not consume much, if any. Does any one know why? Stop and consider. There is more digestible feeding value in a quart of milk than in a quart of oysters. The milk costs, perhaps, four cents, the oysters from 30 to 60 cents per quart.

To Mr. Cook.—I have been informed that you have stated that the Gravity Cream Separator is a fraud. Now, I and a number of farmers near here have been using it for the past three summers as well as winters, and have failed to discover any fraud or that we could not make as good butter as by any other process. Will you please tell us wherein the fraud lies?

Answer.—That's a good introduction, but I'm not going to take back any thing. But what is a fraud? That which represents itself to be something else. The so-called gravity separator is

one, because it is no separator at all. The farmer has been made to believe that it was fully as good as the centrifugal separator; but if you will write to Professor Wing of Cornell University and get their bulletin, you will find that the figures recorded there in a large majority of results, were as high as six-tenths of one per cent. of fat in skim-milk. At our factory we found from four-tenths to one per cent. of fat in the skim-milk. Any deep testing can will skim just as closely. If you want to add water to milk to help to raise cream, go to the tin shop, get a can made, take it home and do it. Don't buy one that costs so much. I can take a can costing 25 cents and do just as good work as can be done with this aquatic can. Of course, just as good butter can come from such cream as from any other gravity process, but the skim-milk, being watered, is not fit for calves or pigs. At least, I would not feed it to mine. Another thing: the system is not new, but old, and is no more or less than any of the old gravity creamers, which never would skim closely. I have put away milk with one per cent. of fat in it, and failed to get any out of it by the gravity process. Your best course is to test your skim-milk with the Babcock. That will decide the question. Remember that the skim-milk is watered one-half.

Which system will get the most cream from milk, the separator or the creamery cans?

Mr. Smith.—The separator. There is no other way possible by which so much butter can be got from milk as by use of the separator, nor one that will produce as good butter, for the reason that the separator removes all the foreign matter. We have tested our skim-milk many times at the station during the past season, and, as a rule, did not find more than three-hundredths of one per cent. of fat remaining. The so-called aquatic separators are a fraud and humbug. Either employ the centrifugal separator or one of the deep-setting creamers. The submerged creamers are the best, such as the Cooley or Stoddard. They are operated on the same principle.

Please name the variety of grain that will produce most butter fat in milk?

Mr. Converse.—We cannot increase the per cent. of butter fat in a cow's milk if she has been kept up to her normal working

condition. In Denmark, experiments were made with 150 cows, for the purpose of ascertaining whether butter fat could be fed into the milk of cows kept up to their normal working condition; the result showed that it could not.

Which make of cream separator will leave the highest per cent. of fat in cream; that is, which will leave it the thickest, and what ought the per cent. of fat to be in centrifugal separator cream?

Mr. Cook.—There are two or three good kinds. The De Laval, United States, Sharpless and others. A separator should skim very close, at the same time it should leave a cream having about 35 per cent. of butter fat.

Do you advise the use of a commercial starter for the ripening of cream?

Mr. Van Wagenen.—I suppose the most of you know what a commercial starter is. The theory of the starter is that we may always have the bacteria necessary to ripen the cream. When the milk is frozen, commercial starters are as a rule the best, because they are free from gas and are clean. There are two or three of them on the market, but I do not know that they are any better than a home-made starter made from pure, clean milk slightly soured.

Mr. Cook.—I would no more think of getting along without a commercial starter than I would without rennet for making cheese. A home-made starter is just as good when made of the milk from one cow, which has been heated up to 170 or 180 degrees to kill all the germs in it, held there for half an hour or more, then cooled down to 70 degrees and allowed to stand until it is slightly acid.

Mr. Van Wagenen.—The starter is almost universally in use in Denmark.

Why does it take so much more churning at some times, to get the butter from the cream from the same cows, than at others?

Mr. Cook.—As a rule, the trouble all lies in the failure properly to ripen the cream. It will not churn unless it has been properly ripened and mixed. No matter how it was raised. The best way is to take a quart of milk from your best cow; have it pure and clean; set it away and allow it to become slightly sour;

then add a small per cent. of it to the cream, which should be set in a jar and placed in another holding twice or three times as much water as the cream; warm that water up to 70 degrees and place the cream jar in it, and allow the cream to come up to that degree, then set it away at a temperature of 60 and hold it till it has a smooth, glossy appearance. It will then be ready to churn, but the temperature at which it should be churned will depend on how it was raised. Centrifugal cream will have to be churned at a lower temperature than that raised by the gravity process. About 60 degrees will be about right. Experiment and find out which degree is best.

If all farmers crowded their cows to their full capacity, what effect would it have on prices?

Mr. Cook.—I suppose that if every cow doubled her capacity this year there would be a depression in prices. In that case I would suggest selling off one-half the cows, thus saving the expense of keeping one-half of them. But that problem does not trouble me at all. We have doubled the product of our dairy within the last 10 years, and yet butter is bringing fully as high or higher prices than it did then. We are feeding our cows $15 to $18 worth of grain each year, but make a profit. Another point. The men who have cows that give 300 pounds of butter each year invariably obtain the highest prices for their product.

Is it wise for farmers to sell milk to a New York city contractor, thus closing cheese factories along the railroads?

Several Farmers.—No.

Mr. Cook.—I have watched the New York markets several years and find that the price paid for milk there is just about the same as it is worth for butter and cheese, with sometimes a slight increase for the by-product. But we have several times paid more for milk than the stations did. The only real value that the stations have been, is the stimulating of winter dairying, but the requirements of the station now are very rigid. Milk must be absolutely clean and be aërated. If a can comes to the station that is not just right it is sent back. I wish we factorymen had the same power those men have and could enforce it as they do.

Can we change the per cent. of fat in a cow's milk?

Mr. Cook.—Not if the cow is giving a normal flow and is fed up to her capacity. At times it will increase, then it will decrease, then drop back below her normal level. I have been trying during the last six or seven years to increase the fat in a herd of grade Holsteins, but have been unable to do it, so far.

Mr. Van Alstyne.—Recently I looked over our book where the Babcock tests are recorded, and found that the tests made every two weeks had not varied more than one-half of one per cent. The herd is made up of Guernseys and high grades.

How shall we prevent the butter granules from running off in the butter milk?

Mr. Van Alstyne.—Oftimes that is a great difficulty, but, if the granules are large enough so that they will stand on the surface of the butter milk, there will be no difficulty. Give the churn one or two more turns, then wait till the butter comes to the surface.

Will dry feed produce as much milk as will wet feed? Would you cut the coarse fodder?

Mr. Cook.—I suppose that means wet or dry grain foods. I have made some experiments in that line and came to that conclusion, having fed five cows on cut and wet feed; but I did not get any more milk from them. I found, also that every time I made any change there was a decrease in the milk flow; also that I got most milk when I fed the long uncut hay. It is better to let the cow wet the food with the saliva of her mouth; besides, she will eat the food more slowly.

What rate per gallon should the milk producer receive for city milk, with hay at $10, gluten feed $18 per ton, corn meal $15, bran $17? At these prices, which would be most remunerative—milk at 10 cents per gallon, cheese at 10 cents and butter at 22 cents per pound net to the farmer?

Mr. Pingrey.—I am not prepared to say, but I think we ought to get at least 12 cents per gallon. It is selling now for 10½ cents per gallon.

Mr. Ward.—I think the milk shippers are offering 10 cents for the season.

What are the farmers of eastern New York receiving per gallon for their milk, shipped to New York?

Mr. Moore.—Last month, at Mount Upton, Chenango county, we got $1.50 per hundred for our milk, sold on the pool system. It went to factories, some into butter and cheese, while some was shipped.

Mr. Fenner.—There are 12 gallons of milk in 100 pounds. You can easily figure the price per gallon.

I have a cow giving 30 pounds of milk per day which tests 3.25 per cent. of fat. If I change foods and make that cow give 10 pounds more milk, will it increase the butter-fat?

Mr. Smith.—No; provided the cow is in a normal condition. As a rule, such a per cent. of increase in milk from a cow testing so low in butter-fat, would result in a slight decrease instead of an increase in fat.

How low in butter-fat can milk be profitably produced?

Mr. Cook.—I don't know. It would depend on the quantity the cow gave. The law says that milk below three per cent. of butter-fat shall not be sold, and I do not believe that a cow giving milk below that per cent. ought to be kept. My opinion is that the cow that gives milk containing four to four and one-half per cent. of fat, with a good flow is the most profitable to keep. We are keeping cows that give about 3.6 per cent. fat, and getting nearly 7,000 pounds of milk per cow; but I am going to put in a herd of Jerseys for the purpose of ascertaining, if possible, which herd (our present one is Holstein-Friesian and its grades) will make a pound of butter-fat at the smallest cost. We have found that it requires about 250 pounds of butter per cow, each year, to cover all the expenses for labor, feed and interest.

Can milk be kept two weeks and give as good a test as milk kept but one week?

Mr. Cook.—There is no trouble in keeping it two weeks. We keep all of ours 15 days and make tests twice a month. We use bottles or cans having glass stoppers, because foreign substances will adhere to corks. There are several substances that are used to preserve the samples. Corrosive sublimate is as good a one as any to preserve the same till we want to test it.

Which is the more profitable, winter or summer dairying?

Mr. Garlock.—Winter dairying is the more profitable, provided we can get a factory that runs through the winter, but it will not pay if but one or two of us go into it.

Mr. Converse.—There are 10 cheese and butter factories in the town of Ellisburgh, Jefferson county, six of which have not closed their doors or banked their fires during the past four years. Our best dairymen discovered some time ago that they could not afford to feed dry cow boarders four months in winter, with nothing to show for it when spring came but experience and scrub cow society. So they began winter dairying. With good clean quarters, good care, good cows, good corn ensilage, some clover hay, wheat bran and oats and peas, we find that we can make as fine butter in winter as in summer, provided the milk is properly cared for and the butter is well made. We have also found that a good dairy cow which drops her calf, say November 1st, will give 1,000 pounds more milk during the year than she will when she freshens March 1st. Besides, the price of milk is from 20 to 50 cents a hundred pounds *higher* in winter than in summer. Another point, if cows are to go dry during a certain season of the year, it will be much more profitable for them to do so when the hot weather, short pasture and flies are here.

Mr. Cook.—Another point, in winter there is not any other farm work crowding, so that one can give more care and attention to the cows than in summer. But if best results from winter dairying are reached, we must have cows come fresh in the fall, and they should be good ones, by which I mean cows that will give not less than 5,000 pounds of milk—they should give 6,000 or 7,000 pounds—during the year, and we should be provided with milk-producing foods, such as Mr. Converse has named, while all the environment of the stable should be of the best. With such cows and such conditions obtaining, if one is so situated that he can draw his milk to a first-class creamery or cheese factory where butter is made in winter, there is no disputing the fact that winter dairying pays better than does that of summer.

What causes "flat" butter?

Mr. Van Alstyne.—I suppose that means butter lacking in flavor.

A Farmer.—Feed the cows some onions.

Mr. Van Alstyne.—They would add flavor, but not just the right kind. As a rule, foods have much to do with the flavor. Such foods as corn-meal, wheat bran and oats give best flavor. Ensilage also gives a good flavor; but at this time of year the milk from "stripper" cows is the cause of lack of flavor. When the milk of fresh cows is added to stripper milk a good flavor is maintained. That is one reason why Elgin butter has its reputation. In most dairies there, fresh cows are constantly being added, which with the foods they are fed keep up the uniform flavor of Elgin butter, which gives it its reputation.

Can 5.5 per cent. milk be successfully made into cheese?

Mr. Cook.—I have never handled any 5.5 per cent. milk, but cheese from richer milk, 6 per cent., has been made with a loss of only thirty-five hundredths of one per cent. of fat. I saw such a cheese recently; but such milk must be carefully handled. It is a mistaken and false notion that such milk cannot be made into cheese. It is also a false notion that milk at this time of year cannot be made profitably into cheese; but it is almost impossible to make a fancy cheese, one day with another, from every other day milk. It will be impossible with such milk to emulsify the fat so as to get out the moisture and get the caseine to hold the fat. In that case quite a per cent. of fat gets away in the whey. But a cheese made from very rich milk must be cured at a lower temperature than one made from poorer milk, for the reason that the high temperature starts the fat more quickly; one may not discern it with the naked eye, but a small magnifying glass will show it. For myself I can say I never worked milk during fifteen days that tested below 3.35 or above 4.2 per cent. In those instances there was no difference in loss of fat, showing that the caseine followed the fat in like ratio. Much higher, however, we know the caseine will drop a little behind the fat. The market shows that caseine is worth only two cents a pound,

so that the loss through the difference in caseine in such milk is seen to be below consideration.

Can a pound of cheese be made from 8¼ pounds of milk?

Mr. Cook.—Yes, if there are solids enough in it. But I have never worked any milk as rich as that. But it is safe to assume that in such milk a pound of butter fat will make about two and a half of cheese.

Why does it take from 11 to 12 pounds of milk at our factory for a pound of cheese, if it can be made elsewhere from 10 pounds?

Mr. Cook.—Possibly it cannot be made from 10 pounds elsewhere. During the hot weather many factories will take from 11 to 12 pounds. When milk is inclined to be gassy it requires more. It is because, when the milk is in a certain condition more fat is liberated and gets away in the whey. I simply took 10 pounds as a basis in my talk to-day. The average with us during the year is a fraction over 10 pounds; late in the fall less than 10 pounds.

Neufchatel cheese.—Is there a demand for it, and is there profit in its manufacture? Tell us something of it.

The Reporter.—It is a small, soft, fancy cheese, put up in small rolls about three inches in length and one inch in diameter; then covered with tin foil. I do not know what its present price is, nor whether there is more profit in it than in our Cheddar cheese. There is a large factory at Antwerp, Jefferson county, where this cheese and several other fancy varieties are made; it is also made at Adams, Lowville, Fayetteville and at a factory near Middletown, Orange county.

What salt is best for dairying?

Mr. Cook.—There are several brands of salt made in this country which are good. We have used nearly all of them, buying in car lots. All of our best American salts are better than those imported, because they do not have the opportunity to become contaminated on shipboard.

What causes white curds that are found in butter?

Mr. Cook.—They are either bits of caseine or else flakes of dried cream. If the milk is creamed in the shallow pans we often find

these specks. A good way is to cover the pans with pasteboard covers, or hang wet sheets in the room. These specks are mighty hard to get out of the cream and the best way is to cream the milk in the deep setting cans or by the separator.

What is process butter and where is it made?

Mr. Cook.—It is butter, the refuse from the stores in the west and elsewhere, melted up, purified with chemicals, re-churned, mixed with other butter, worked and packed, then put upon the market. The fraud is of selling it for creamery butter. In Utica there is much of it now being sold. It is difficult to detect the package owing to the color of the letters on the stamp. In this way the law is evaded.

What causes spots—mottled like—in butter?

Mr. Cook.—Nine times out of ten they are caused by an uneven distribution of the salt. Begin when the butter is in the granular form; sift on fine salt, distributing it evenly; use a wooden fork to turn it over; allow it to stand 15 or 20 minutes. Then work it. In this way the mottles or spots will be avoided.

Does it pay to aërate milk to be taken to a cheese factory in summer?

Mr. Cook.—Most assuredly. The town of Ellisburg, in Jefferson county, has 360 farmers who milk nearly or quite 6,000 cows, the milk going to the 10 or more cheese factories in the town. Had each one of those 360 dairymen used an aërator last year it would have increased the value of their milk enough to have paid for an aërator and left a balance of $600 for the town. In other words, the value of the milk product in the town would have been increased last year $2,000. And yet such care of milk is no more than is enforced by the milk shippers and condenseries.

A Farmer.—Suppose every farmer made butter only in the winter, how long before the price would be down?

Dr. Smead.—Possibly there would be a drop, but everybody is not going to do that. Then, too, with a good silo and ensilage butter can be made more cheaply in winter than in summer. Another point, a cow coming fresh in the fall will give 1,000 pounds more milk during the year than she will if she drops her calf in the spring.

Who is benefited by taking good care of milk that goes to a creamery?

Mr. Cook.—Every one of the patrons, the butter-maker, and lastly the consumers of the butter.

Of what benefit are the milk stations going to be to the farmers?

A Farmer.—We have one at Lafargeville, none nearer. I think it a benefit. It keeps up the price of butter and promotes competition.

Dr. Smead.—From my own observation I am satisfied that the station near me has benefited the farmers. The price of milk is higher, the cow is better fed and cared for, and the burden of the housewife has been lessened thereby. Besides, it has made another outlet, and anything that adds a string to the bow of the farmer is a benefit to him.

Mr. Cook showed a chart on which were stenciled figures showing the value of milk, taking 20 cents a pound for butter as a basis, for both cheese and butter, and said that all depended on the value of the milk in butter fats. If the milk is rich in fat, at present prices for milk, more money will be got out of it for butter, provided that milk is sold by the quart. If it is all pooled, such milk should be made into butter.

How should milk be cared for that it may keep in perfect condition for delivery to the creamery or cheese factory?

Mr. Dawley.—I like that question. Now I hope you will like my answer. Do not think I am "fussy." The questioner wants to know how the milk can be delivered in *perfect* condition and I will lay down the following rules:

The care of milk should begin before milking, by seeing that the cow or cows are clean, the stables and surroundings clean, as well as the utensils, and last but not least that the milker is clean.

Before commencing to milk, the cow's udder and flank should be wiped with a damp cloth or brush. By doing this, loose hairs and fine particles of dust and filth will be prevented from dropping into the milk pail, and much cleaner milk will be secured. The milking should be done with dry hands, and, to get the best results, should be done gently, yet quickly. Immediately after milking, the milk should be removed to a place where the surrounding atmosphere is pure, and then strained at once; for no

matter how carefully it may have been drawn, there will be some dirt in it which should be strained out at once.

Air the milk frequently by dipping or pouring, or by the use of an aërator. With regard to aërators, if they are used properly and kept perfectly clean they are a good thing, but, if kept only half clean, they are a curse to the business, for a dirty aërator will spoil all the milk that goes through it.

In the very hot weather it will be necessary to cool the milk by the use of ice or water, but be sure that the milk is thoroughly aired before doing so, and do not cool the milk below 68 or 70 degrees, as it will keep quite sweet over night at this temperature and will arrive at the factory in much better condition for cheese-making than if it had been cooled to 55 or 60 degrees.

Always remember that milk requires airing just as much in cold weather as it does in hot or warm weather, for gases and animal odors are present at all seasons, and should be allowed to escape by airing immediately after milking.

Keep the milk in small quantities over night, and do not mix the hot and the cold milk. Send the night's and morning's milk to the factory in separate cans if possible.

When the whey is returned in the milk cans, empty them at once, wash with warm water, then scald and place them where they will get plenty of sunlight and pure air. See that the place where the milk is left over night is clean and away from anything that will produce a bad odor.

Occasionally, and the oftener the better, during the evening, the milk should be aired by dipping or pouring, thus preventing the cream from forming a leathery scum, which hinders the escape of taints. If the cream is allowed to rise and become exposed to the air it will become tough and leathery and will not mix with the milk, consequently a greater quantity of the fat is lost in the whey. The maker may get the blame when in reality it is the careless patron who is to be blamed. Do not leave the milk cans flat on the ground or against the side of a building over night, but raise them on scantlings or something similar, in an open space, so that the air will circulate freely under as well as around the can.

A very good plan is to rinse the cans with a pail of cold water before putting the milk in them. See that your cows have plenty

of good succulent fodder when the pastures are getting short, with free access to salt every day, and an abundant supply of pure water. As there is 87 per cent. of water in milk it is very essential that the water should be pure.

Causes of Tainted Milk.—Some of the causes of tainted milk are: poor, decayed fodder; dirty water, whether used for drinking water or for the washing of utensils; foul air in the cow-stable or cows lying in their manure; lack of cleanliness in milking; neglecting to air the milk rapidly directly after milking; lack of cleanliness in care of the milk, from which cause the greater number of milk taints arise; mixing fresh and old milk in the same cans, and dirty or rusty tin pails and cans.

It should always be remembered that pure milk can only be obtained from healthy cows, pure feed, pure water, pure air and clean handling. Every patron's cash receipts are affected by the way his brother patrons produce and handle their milk. Hence the necessity of each adhering to sound rules based on sound dairy sense. In not a single first-class factory in the land are good prices obtained for the product except where all the patrons practice thorough cleanliness in the care of milk. It is a matter of profit for each to do this.

SUGAR BEETS.

From what information you can get and have received, are the farmers generally satisfied with the results obtained from sugar beet cultivation?

Dr. Smead gave some results as reached in his county near Seneca lake: Last year most of the farmers were satisfied with results. This year the drouth has shortened the crop, but he has learned that the percentage of sugar is greater this year than last, but that as the price will be no higher than it was last year, the growers object. All in all, he thought the farmers would continue raising them. There were about 40 acres grown in his locality this season (1899), the crop going to Binghamton.

Mr. Cook.—The sugar beet is a new money crop and no doubt will prove a good thing in some localities, if properly grown. But I do not believe any of you will get rich all at once by growing it. I would not rush into it too far at first; but, don't think I want to throw cold water on the enterprise. It is well to try it; then note results.

What success have our beet sugar factories had in increasing their output and numbers?

Mr. Cook.—Mr. Rogers of the Binghamton beet-sugar factory, said they were greatly encouraged. Their crop last year was 30,000 tons, against 20,000 tons the year before, while next year's tonnage will be still larger. Doubtless there will be one more factory built in the State this year, which will be at Lyons, making three factories in the State. The growing of sugar beets adds another money crop for the farmer, and I think it will grow and crystallize in a short time so that we will know what we are doing.

Mr. Harmon.—We grow cabbage here, which is a better crop than sugar beets ever will be with us.

Is the Unadilla Valley suitable for growing sugar beets?

Mr. Moore.—They will grow here and give a good per cent. of sugar, if the season is favorable. I sowed some seed last spring but it did not grow; the drouth was the cause of failure.

Which is the best money crop, sugar beets or potatoes?

A Farmer.—Sugar beets; but it is more work to grow them unless one has a weeder. We got $50 last season off an acre and a half.

Two or three farmers said that, all things considered, there was more money in potatoes at 25 cents a bushel than in beets.

Another farmer said he got $50 last season off an acre. The yield was 10 tons; but there was a majority of two to one in favor of the potatoes at South New Berlin.

Mr. Cook.—I think, as a rule, we have not been educated up to the point of successful sugar-beet growing; I also believe that we are to grow more of them, but that the work will be largely done by foreigners; and I hope the Legislature will keep up the bounty appropriation just as long as its conscience will permit. Let us raise all we can and save as much of the money as we can which we are yearly sending abroad to purchase this crystalized sunlight.

What is the expense per acre of growing sugar beets?

Mr. Cook.—Have any of you here grown them?

O. E. Wolcott of Corning.—I grew 20 tons of beets per acre at a cost of $30 per acre. I used fourteen pounds of seed.

One-half the cost will be saved if the ground is plowed early and harrowed several times to kill the weeds. Sugar beets pay better than any other crop grown on my farm. One advantage is that the crop is sold before it is grown, while the soil is left in fine condition for succeeding crops. One firm in Syracuse grew 132 acres last year and this year will put in 300. Around Hornellsville, some are offering to take 50 acres. Mr. Rogers at Binghamton had 37 acres. The total cost was $655,52; the yield was 14½ tons. After paying for fertilizers and every item of cost, the expense was $25.77 per acre. All work except the thinning can be done with a horse. The hardest thing is to get a good stand and plenty of seed should be used; and do not put it over an inch deep. Cultivate with a small toothed cultivator. The secret of success is never to let the weeds get a half inch high. A good fertilizer is one containing 4 per cent. nitrogen, 8 per cent. phosphoric acid and 10 per cent. potash.

Will Mr. Rogers, who is present, give us some data as to results reached from the sugar beet crop, at the Binghamton beet sugar factory since it was opened?

Mr. Rogers's answer is condensed. He is president of the Binghamton beet-sugar factory and has had much experience with sugar-beet growing and the manufacture of beet sugar. He has used every means for the purpose of ascertaining if the growing of the beet by the farmer, and the manufacture of sugar from them could be made profitable. The results so far have proved highly satisfactory, and his company has been enabled to increase its contracts for next season's crop nearly 100 per cent. over those of last year. He said that the number of beet-sugar factories and the manufacture of beet sugar has nearly doubled in the United States during the last two years. The average production per acre in the Binghamton factory's bailiwick last year, although it was one of the driest seasons he has ever known, was fully two tons per acre more than it was the year before, which shows that the farmers had become better educated in the knowledge of how to grow the sugar beet. There is no crop that will pay better, if one has a fairly good soil, than will sugar beets. It is possible to grow beets, and get good pay for our labor, the fertilizers used, and the interest on the value of the land, and give a good profit. All the work done was done with a good

profit. All the work was done with a horse, the rows of beets being twenty inches apart and the plants thinned to eight inches in the row. Two years ago Mr. Rogers grew twenty acres at a total cost of $27.02 per acre. Last year he grew thirty-seven acres at a cost of $17.27 for labor and interest, to which should be added $5 for fertilizer and $1.75 for seed per acre.

"But," said Mr. Rogers, "we want good land, well fertilized, and the beet must receive good care. It will not pay to expend money and fertilizers on poor land. It does not cost any more to grow a crop of 14 tons or more per acre than it does to grow 10 tons. Therefore, have the ground rich, plowed deeply and well pulverized, so that the seed-bed will be fine. This enables the seed to germinate. If the ground is inclined to bake before the seed germinates, go over it with a wire-tooth horse-rake. It is better than is the weeder, because the teeth draw more flatly over the ground."

What formula of commercial fertilizer do you recommend?

Answer.—One having 4 per cent. of nitrogen derived from nitrate of soda or dried blood, 8 per cent. of phosphoric acid, and 12 per cent. of potash, using either the muriate or the sulphate. When the land is good, well fertilized and the crop well cared for, there can be a profit of $15 to $25 per acre realized.

Mr. Rogers, to show how the growing of the beet has increased, said that Smith and Powell of Syracuse, grew, two years ago, 15 acres, and last year 130 acres, and they have contracted to grow 300 acres this year. They have grown cabbage and nearly all other truck crops, but they had told him that they had never grown a crop so profitable as sugar beets.

THE SHEEP-FOLD.

What about sheep as moneymakers on a farm. Best breeds and management?

Dr. Smead.—There are a great many things about sheep which the best breeders do not yet know. To breed sheep successfully one must know the sheep and its habits and how to breed and feed it. Then, too, one must select the breed he likes best. Having selected it, feed and care for it as it is cared for and fed in its native home. Nearly all our sheep breeds come from England.

There they are fed succulent foods such as roots. Here we give dry feed and grain. The shepherds of England feed but 16 bushels of grain to their flocks, while we feed an average of 47 bushels. If profit is to come, we must aim at a certain production, which should be mutton, or, rather, lamb. So select the breed that will produce the most and best, first selecting the one you like best. When all the knowledge of the sheep needed has been obtained, there will be money in them. But one must constantly make selections of the breeding ewes, keeping those that are the best, so as to get the most lambs, which should be dropped as early in the season as possible.

What breed of sheep is best for all purposes?

Dr. Smead.—The one that the man under his individual conditions can make the most money out of. But the soils and climate of this State are favorable to the keeping of any and all breeds, so I am going to say that, if one will study the individuality of either one of them, and feed and care for it as he should, money can be made from it. It will depend, not on the breed, but upon the man who handles it. But be sure to have the breed or else keep scrubs, and scrub it through life.

What is the best variety of rape for sheep?

Mr. Ward.—Dwarf Essex is the best variety. I have been reported as saying that Dwarf Victoria was best; I have never said anything of the kind. If anybody asks you to feed it, do not do it, but get the Dwarf Essex seed which you may obtain of William Pennie, Toronto, Canada.

How many sheep can I keep on the food one cow ought to have, keeping both in good condition?

Dr. Smead.—It would depend on the sheep, its breed; the cow, and her breed. In my boyhood days the rule was ten sheep for one cow, both being grades. In those days we saw many dead sheep lying around the barn yard, and later, when the March storms came, many dead lambs. In those days it was possible for ten sheep, weighing 100 lb. each to go through the winter for about the same cost as a cow weighing 1,000 pounds. To-day it cannot be done. It requires food to support ewes that are to

produce lambs. Such ewes as I keep weigh about 140 pounds, so that both being well fed, five sheep in the place of one cow would be about the ratio I would name.

What do you consider the best or most proper grain for sheep?

Mr. Ward.—I feed ensilage once a day; the other ration is one made of wheat bran and ground oats with perhaps a little oil meal added. I should never feed corn when I had ensilage. Unless one wants to fatten sheep, do not feed them corn. I have experimented as much as has any man in the State, in feeding corn to breeding ewes, and I am going to say that I never fed it except at a loss. I do not believe that any man can feed corn to breeding ewes without endangering the loss or injury of their udders. I have tried it, and, as a result, had to take them out to the woods and never bring them back again.

Would you advise breeding ewes the first year of their lives?

Mr. Ward.—I would never breed ewes before they were a year old. There is always a greater or less loss of lambs from such ewes.

How old should a ram be when used in the flock?

Mr. Ward.—One year; but five years is better.

What breed of sheep are best for winter lambs?

Mr. Ward.—I suppose by the question that lambs fit for markets not later than February are meant. For such I would have a large per cent. of Dorset blood. But there is fully as much in the feeding as in the breed. Such lambs must be fed and pushed constantly. Feed oat flakes, wheat bran and oil meal and there should be some sugar fed. I know of a man near Rochester who keeps 100 breeding ewes and sells his lambs in New York for $10 each.

Which breed of sheep is most profitable for both mutton and wool?

Mr. Ward.—There is no good sheep for both mutton and wool. Either make one or the other a specialty: For mutton I would not keep the Dorsets but some one of the dark-faced breeds.

Which is the best way to make an ewe own her lamb?

Dr. Smead.—As a rule, one way is to take the ewe entirely away from the remainder of the flock. In a day or so she will own the lamb. If her lamb dies and you wish to substitute another, take the skin off the dead lamb and put it on the back of the adopted one. As a rule, she will own it, and, within 24 hours, the skin of the dead lamb my be removed, while the ewe will continue to own the lamb as her own.

Is cabbage a good food for sheep?

Dr. Smead.—I shall grow some next year to feed sheep unless the price gets too high. To-day the price is $10 per ton, but they weigh like lead, the head averaging five pounds, the bulk going to the sauerkraut factories. Cabbage at $10 per ton, however, costs too much for sheep food, but is an ideal food for the lamb, and, after the heads have been removed, if the lambs be turned on to the ground they will do very nicely. The Danish variety is the best for shipping. It does not pay to fight the worms when cabbage are raised in a commercial way, for the reason that there are no more butterflies around a ten-acre field than around a small patch in the garden. Persian insect powder blown on to the plant with a bellows will kill the worms.

How long is it since lambs have been as high in price as they are now? What is the prospect for higher prices?

Mr. Cook.—The outlook for such lambs is now very good, fully as good as before the war.

Which would be most profitable, 10 sheep or one cow, including price of labor?

Mr. Van Dreser.—Just now, I would put on the sheep, but would raise some one of the mutton breeds, and make lamb-raising—not wool or old mutton—the object. Still, I should keep a few cows, if I could, because I do not think it good policy to have all our eggs in one basket.

What is the best grain for ewes which are suckling lambs?

Mr. Ward.—We are now feeding our sheep ensilage and bean pods. Wheat bran, ground oats and a little oilcake are good grains to feed sheep when grain is substituted.

Which is the most profitable at present, sheep or cows?

Mr. Barlett.—It will depend on the man. We are all differently constituted. Some of us prefer one breed of cows or stock, another man another. If a man prefers Guernseys, he should insist on that breed; the same is true of Shorthorns, Jerseys or Ayrshires. It is so with sheep; but one should get the breed he most prefers, and I believe there is as much money in a flock of good sheep as in a herd of dairy cows; by which I mean a herd of *good* cows. But one must be acquainted with the sheep, its habits and diseases. They are very sensitive animals and are subject to many diseases, and when disease gets into a flock it is very hard to eradicate it and bring the sheep back to normal conditions. We may doctor a sick cow and bring her back, but it is hard to do so with a sheep. Sheep will pay with one man and be a loss to another.

POULTRY POINTERS.

To Mr. Van Dreser.—Is animal meal what it is "cracked up to be" to feed laying hens?

Answer.—Animal meal is very good. The hen craves meat. If she does not get protein meat she will pick feathers off from another, or another's combs. Dried blood or meat scraps make good rations.

How much green ground bone ought to be fed to 20 hens, and how often?

Answer.—We feed about half an ounce twice a week, in the morning ration, mixing it with the grain food. It costs but little and may be bought in Schenectady.

What breed of hens do you keep?

Answer.—The White Leghorns, single comb, which we keep as long as they respond in eggs, at a profit. We have some that are six years old.

Will Mr. Van Dreser give us his net profit per chicken?

Answer.—We made a whole lot of mistakes at first, because we did not keep laying hens and had not studied their makeup. When we had become educated, we cleared $1 per hen. Last year, they paid us more than that, but it did not all come from eggs;

some pullets went to San Francisco, at $3 each, and we have sold roosters for $25 each. Then too, we get pretty good prices for eggs, having received 47 cents per dozen for them, this winter.

Will Mr. Van Dreser tell us how his hen houses are ventilated? Also, how many hens he keeps in one flock?

Answer.—We have six-inch pipes that come to within six inches of the floor and which terminate in a cowl in the roof. There is a damper near the lower end, which is kept closed during the night and opened in the morning. These tubes are made of galvanized iron. They are 30 feet apart. This system keeps the rooms dry and the air pure. No frost accumulates. We keep 50 hens in a flock.

How much hen manure do you get, and how do you save and utilize it?

Answer.—The hens are making about fifty bushels of manure per week. Land plaster is plentifully spread on the platforms under the perches, to absorb moisture and prevent the loss of nitrogen, and the platforms are carefully cleaned twice a week. The manure is kept in barrels in a dry place and run through a threshing machine cylinder in the spring. When the winter wheat has been sown, the finely prepared hen manure and plaster is broadcasted over the fields.

What pattern of incubator do you use?

Answer.—"Prairie State." We have enough of them to incubate 1,400 eggs at a time, about 80 per cent. of which hatch.

Why are eggs less fertile in winter than in summer?

Answer.—Because the hens are kept indoors more than in summer, and therefore do not get proper exercise.

At what time of day is it the best to feed warm mash to poultry?

Answer.—We feed it in the morning. Prefer that time to the noon hour.

What amount of land is required to raise sufficient sunflower seed for 100 hens? How much animal meal in the morning ration for 100 hens?

Mr. Van Dreser.—We put in a half acre of sunflower seed in drills, one seed in a place, 18 inches apart, rows three feet apart.

We had 65 bushels of nice, clean seed; sufficient for our 2,500 or 2,600 hens, but it must not be fed too heavily, as it is very laxative. Three pounds of animal meal to 100 pounds of mixed meal will do for 100 hens.

Do you think that chickens ought to be in places where hogs or other animals are kept?

Answer.—I wouldn't do that. No respectable hen ought to be compelled to associate with hogs, nor would I allow a hen to roost on a carriage top. Give them a place by themselves.

Will hens lay in a room where water freezes at night, if they have the proper foods?

Answer.—I think so, if the hen house is not cold, so as to cause the hen to freeze her comb.

What is the best feed for laying hens in winter?

Mr. Converse.—It is a physical impossibility to make a fat hen lay eggs. They must have protein foods. Our plan is to feed a warm mash in the morning, made of a mixture of 200 pounds of coarse wheat bran, 200 pounds of ground oats and peas, 200 pounds of yellow corn meal and 100 pounds of animal meal. It is all mixed thoroughly and wet with skim-milk if we have it; if not, warm water is used. The whole grain ration is composed of one part of corn, one of wheat. This is scattered in the straw on the floors, and the hens allowed to work for it. They should also have some vegetables such as beets and cabbage; also something to make shell, such as ground oyster shells; also dust baths; and there should always be provided an abundance of pure, clean water.

Dr. Smead.—Mr. James Rice of Yorktown, well known to many of you as an institute speaker, is a breeder of poultry on quite a large scale, having at this time about 600 white, single-comb Leghorns. His winter ration is whole wheat, three quarts to 50 hens, sprinkled broadcast in whole straw on the poultry house floor. The straw is about a foot thick and the hens are forced to work for the wheat, which gives them plenty of exercise. This for the noon meal. Corn is fed at night for the hens to "go to bed on," and for the purpose of keeping up the grinding process in the crops.

For the morning meal a mash made from the following formula is fed: 100 pounds of ground oats, 200 pounds wheat bran, 100 pounds corn meal and 50 pounds of Bowker's animal meal and 50 pounds old process oil meal. This is thoroughly mixed and a warm mash made of it, either by the use of warm water or skim milk, and only enough fed to be eaten cleanly. Care is also taken to have the feeding troughs perfectly clean and sweet, and all the pure clean water kept in a handy place but where the hens cannot get earth or straw in it. Ground oyster shells are also used for shell material and dust baths are placed in every room. Early mown clover—aftermath, is best—cut finely and steamed, is also fed. It is an excellent nitrogenous food for the hen, as the egg is largely made up of albumen.

Mr. Litchard.—The last thing I did before leaving home was to mix the hen ration, which was cracked corn and wheat. In the morning we give a bushel of ensilage to 100 hens; beets are also good for laying hens; so are cut bone and cracked oyster shells; also meat scraps; if you live near a market buy refuse meat, grind and feed it.

What is Mr. Van Dreser's ration, aside from unground grain, millet, wheat and sunflower seed, for his laying hens?

Mr. Van Alstyne.—Mr. Van Dreser has gone, but, by reference to a memorandum, I find it to be 100 pounds of oats and peas, ground, 100 pounds of wheat bran, 100 pounds wheat middlings with 50 pounds of Bowker's animal meal. This is all mixed and enough wet with hot water and sprinkled in the V-shaped troughs to last about ten minutes. It is all eaten up, and the troughs kept clean. This is the morning ration. The grain ration is fed at noon, and corn for the supper meal.

What is the best food for young chickens?

Dr. Smead.—I don't know. Some of you chicken-raisers tell us. Don't sit here, "keep mum," then go out and discuss the question.

Mr. Watson.—Hard boiled eggs to begin with for a few days, then Johnny-cake, followed with cracked wheat.

Mr. Converse.—They should have some mineral matter. The young chicks will pick at something white, so I give them pounded egg shells.

A Farmer.—Old earthen ware, made fine, makes a good grinding food for young chicks.

Give some ideas for making a home-made chicken brooder?

No one present knew how to make a brooder. Mr. Van Alstyne said that he believed it would not pay to attempt to make a home-made affair.

Which makes the best hen house, stone or wood?

Mr. Ward.—Wood, every time, for cows, horses, sheep, hens or anything else.

Should hens be shut up when the weather is cold, or be allowed to run about?

Mr. Ward.—If one has a shed not open to the weather, perhaps it would be better than a very warm hen house. Give them exercise, but in no exposed place.

How is it best to give water to hens?

Mr. Everett.—We water our hens in a galvanized iron pan two inches deep. The object is to have the pan so shaped that the hens won't get into it.

wnat will make hens lay eggs?

A Lady.—Plenty of good food.

Dr. Smead.—As a rule, the ladies are the most successful poultry-raisers, and I wish the lady would tell us.

The Lady.—I can't talk.

Dr. Smead.—Then I will give my method. First have the hen house warm, light and dry, and free from vermin. Then feed wheat, skim-milk, meat scraps and vegetables, scatter the grain ration in the litter on the henhouse floor and make the hens scratch and work for it.

How can you distinguish a hen that is laying eggs, from one which is not?

Mr. Converse.—By the color of her comb, and the way the hen appears when you go into the pen. Sometimes a hen gets too fat; in that case she presents a sluggish appearance.

Is poultry, as it is usually kept on the farm, profitable? If not, how shall it be made so?

Mr. Stevens.—I do not know any branch of stock farming more profitable than poultry, nor of any better markets than those along this river—the Hudson. We are sending money to Europe for most kinds of stock, which ought to be kept at home. Select the best breeds for eggs, care for them well, feed them properly and you will reap profit from poultry. There are several good breeds. The white and brown Leghorns and the white and barred Plymouth Rocks are among them.

Which is the best pattern of incubator?

Mr. Converse.—There is but little difference between the values of three or four varieties. The "Prairie State" is a good one, but there are others just as good. They are very much like the mowing machines; as a rule, all are good. But there are some cheap incubators being advertised. Don't buy one of them unless some one whom you know has experimented with it. Go slow. Buy the best.

Which is most profitable to use in hatching chickens, the hen or incubator? Which is best?

Dr. Smead.—When we kept Brahmas we had no difficulty in finding a sitting hen. The Leghorns will not stick to the nests. If one is going to make a business of raising chickens on quite a large scale, I would buy an incubator. Sometimes, I think I will buy one for the neighborhood and let everybody use it. An incubator, however, will not run itself, so it must be looked after by someone who will follow the directions of the maker, and it costs no more to run one having a capacity of 200 eggs than one of a less number, and I believe that the incubator is the coming "hatcher," whether for a large or small number of eggs. There are several patterns, all which are good, the "Prairie State" being as good as any.

Mr. Rice.—All will depend. If one is engaged quite largely in poultry-raising, and will give proper attention and care, use the incubator and brooder. If only in a small way, say 50 or 100 chicks which are to be given the usual farm care, get a few good old fashioned Barred Plymouth Rocks, and give them the job of

hatching the chicks. This breed of hen will stick to the nest till the last chick comes out of the shell, while no better or more devoted hen mother ever clucked or cackled. Then, too, when she has done laying eggs and rearing chicken families, she will be found one of the best of fowl for the table. But do not attempt to hatch chicks by using a white Leghorn. She will start in with a great deal of hurrah and preparation, but in a few days will leave the nest and begin laying eggs again. In that respect, she is quite like some men who are never contented to stick to one sort of work more than a week at a time. But the Barred Plymouth Rock is not built on that plan nor along that line. When it comes to going on the nest and hatching chickens she will always be found a "stayer."

What breed of poultry pays best on a small farm?

The Reporter.—The one that pays best on a large farm. Why not?

Mr. Ward.—Mrs. Hollister recommended, yesterday, the Buff Leghorns and gave statements of very extraordinary yields. Of 20 breeds she has found this one the best.

Are oats a good food for hens? If not, what are the best foods for laying hens?

Mr. Wall.—Oats are best when ground with corn and fed in a mash, to which may be added equal parts of bran and middlings, vegetables, cut clover or clover meal, and some animal food. Grit in some form and pure water are essential. Wheat is the best whole grain for all seasons. Corn in moderation is a good ration for the evening feeding in cold weather. It pays to warm whole grain and feed in a litter.

What is the comparative cost of a pound of chicken with other meats on the farm?

A Farmer.—I have found that, one year with another, a pound of chicken can be purchased as cheaply as a pound of any other meat on the farm, and I am satisfied that a pound of it pays twice as well as does a pound of pork. I began a few years since with fifty hens, and have increased the flock to 500, and find I can make $1 net per hen. It does not

cost me any more to keep eighty hens than it does to keep one cow. If I can get $1 per hen, you see I am getting nearly three times as much from the hens as from the cow. I have 150 White Leghorns, the others are mixed, but the record for the entire flock is nearly 200 eggs each per year.

What is the best yield of eggs from 50 hens?

Mr. Cook.—For one I will say I do not know, but I believe that Mr. Wyckoff of Tompkins county, holds the record from 100 or more. No one present could give a report from a flock of fifty.

A Farmer.—I know a minister whose Plymouth Rocks produced 215 eggs each last year, and they are not ranked as special-purpose fowls, either.

Mr. Ward.—I mistrust there is something the matter with that minister's bookkeeping. The best record I have ever heard of, was 198 eggs per hen. I guess that some other hens must have got in and laid in those nests.

What is the cause of hens pulling feathers, and is there a cure for it?

Mr. Chapman.—It is a habit with some hens. When one has it, cut off her head. As a rule, however, it is caused by a want of albuminoids in the food. Give them some oil meal, meat scraps or other like foods; cut clover in winter is also a good food.

What are the best methods of preserving eggs, and how long will they keep?

Mr. Ward.—We don't want to preserve eggs, but eat or sell them as fast as they are laid. We have heard enough about cold-storage eggs. One can hardly go into a hotel and get fresh eggs. Keep and feed the hens so that they will lay right along.

Mr. Chapman.—If it were not for cold storage, eggs could not be given away in summer. But eggs may be preserved in lime water, although the system is too expensive.

A Farmer.—I have limed eggs, and they came out in such fine condition as to defy inspection. I had no difficulty in selling them for 22 cents per dozen.

Mr. Ward.—Possibly, but I would rather have newly laid eggs, and I believe that most customers prefer them to salted, limed or cold-storage eggs. As to the keeping qualities of preserved or cold-

storage eggs, I know nothing, but I think that such eggs would have to be eaten very soon after being exposed to normal conditions.

A Farmer.—Is it essential to feed oyster shells in the summer?

Mr. Gould.—Yes; they will eat as many in summer as in winter.

Mr. Laird.—I find that our hens do not eat nearly as many shells in the summer as in winter; another thing, unless a hen is laying eggs she will not eat many shells.

Mr. Cook.—It will depend on the soil and conditions; if the hens have a large run and the soil is not too clayey the hens will not eat many oyster shells in summer.

What is the best general purpose fowl?

Mr. Ward.—We do not want any "general purpose" fowl. Get a special purpose fowl. We can't ride two horses in opposite directions at once. Either have an egg-producing or meat-producing hen.

Mr. Converse.—Nor do I. I have no use for general purpose hens, cows, horses, hogs, or dogs. Special purpose animals or fowl is my motto every time.

What effect has venetian red on eggs?

Mr. Cook.—I don't know what the writer means by the question. Perhaps he thinks that to paint the hens red he can get Easter eggs that way; but I will not paint my White Leghorns.

Which breed of turkey is the most profitable?

Mr. Chapman.—The bronze; they may be made to weigh 20 pounds each.

Which breed of hens are best for egg production?

Mr. Chapman.—In our town, one may go its whole length and find nothing but White Leghorns. The Plymouth Rocks are a hardier bird, but not so valuable for egg production.

How best to manage turkeys the most profitably?

A Farmer.—Feed them.

Mr. Cook.—I am told there are a thousand turkeys near here—Rodman—that are to be slaughtered for Thanksgiving. Will some one tell us how to feed turkeys?

A Farmer.—We begin with bread and milk, which is continued about four weeks. Then we feed grain, beginning with wheat. Later on other grains are fed.

A Farmer.—If you wait till to-night I will bring my wife down, who will tell you all about it. She is at home to-day, picking turkeys. It is a trick to raise them, and do it well, but she knows how to do it.

What is the best food for young turkeys?

Dr. Smead.—My wife raises turkeys. She has fed bread, but occasionally a turkey would go wrong, then die. Now she feeds a custard with the sugar out, the first month; this is followed with oatmeal later. When the large feathers begin to grow, the birds are troubled with what we term "droops" and die. It is a critical time and I am convinced that it is caused by a want of protein food, so we feed ground fresh meat scraps fined in a sausage cutter. It seems to meet the requirements of the case very well indeed.

What is the best way to feed sour milk to hens?

Mr. Cook.—Sour milk, if the curd is in it, is a valuable protein food, for the hen, but it ought not to be allowed to become too sour. Place it where the hen can eat it, but do not feed too much, and be sure to keep the feeding dishes clean.

What shall we do to cause hens to molt?

Mr. Ward.—Sunflower seed is the food used by Mr. Van Dresser, to hasten the molting season.

How large should a hen house be for 100 hens?

Mr. Converse.—We allow about four square feet per hen, when the hens are kept continually in the building. We keep 50 in a flock.

What causes "gapes" in chickens and what will prevent them?

Mr. Van Alstyne.—Gapes in chickens come from a worm in the soil, and it is said the gape worm comes from the angle worm, and it is most prevalent when the chickens run on old angle worm infested ground. When the coops are placed on sod ground or on

board floors, gapes are seldom seen. Air-slaked lime sprinkled lightly on the chicks will cause them to sneeze out the worms, at times, and they are sometimes removed by the use of a feather.

Is it not better to feed soft food to hens at night than in the morning?

Mr. Stevens.—I have experimented on both lines, with both the American and Asiatic breeds, and have concluded to feed the warm mash in the morning. At noon, grain, made of a mixture of two-thirds oats and one-third corn. I do not know that I would make any difference between white and yellow corn, except for exhibition purposes. For those I would feed white flint corn. It is known as "white sanford."

Are beets better for hens than flat turnips? Will hens eat turnips as well as beets?

Mr. Rice.—I think a ton of beets is worth more to feed hens than an equal weight of flat turnips. They are sweeter and juicier. The actual difference in food nutrients, however, is very slight. Figuring from analysis, we find that in a ton of mangels there are 2.2 per cent. protein, 10.8 per cent. carbohydrates, 2 per cent. fat; flat turnips, 2 per cent. protein, 14.4 per cent. carbohydrates, 4 per cent. fat. The nutritive ratio for the mangels is 1 of protein to 5.1 carbohydrates, and for flat turnips 1 of protein to 7.6 carbohydrates. The real difference is more on account of the tenderness and fine flavor of the beets. Notwithstanding all this, we always raise plenty of turnips for the hens, because it is so much cheaper to produce them. In fact, we have nearly ceased raising beets. They require the whole season to grow. They must have exceptionally rich ground to make a good crop, and of necessity need considerable care and some hand weeding. They are expensive. The turnips we sow broadcast after early potatoes or in the corn or young orchards at the last cultivation. They hustle for themselves. All we have to do is to pull and top them. They are therefore cheap; while hens usually prefer raw beets to raw turnips; they like both. Cooking greatly improves the turnip; when it is boiled and mixed in with the ground feed it makes a very savory mash. The fowl like it. If you don't believe it, try it.

THE DAIRY COW—CARE AND FEEDS.

Do you recommend the keeping of cows in the stable constantly in winter?

Mr. Terry.—Not if they are milch cows. The modern cow is purely an artificial one, and she should have abundance of fresh air, and exercise. We used to hear it said that we must keep cows constantly in the stables in winter, in order to secure more butter fat, but there is something else to be considered beside butter fat, and that is the cow's health and that of her progeny.

Are raw potatoes good to feed milch cows? If not, why not?

Mr. Terry.—Yes; in small quantities; not more than four quarts per day at first. Possibly, later the quantity may be slightly increased. But they are a starchy food and should be properly balanced with some protein foods.

What shall I feed, if I have timothy, in place of clover?

Mr. Cook.—You all know the difference between timothy and clover. The latter contains about twice as much protein as does the former. The cow must have the protein. It is not in timothy hay. If you feed that, you will have to feed more wheat bran, gluten, linseed or some other protein grain, than if you fed clover. I could not answer the gentleman's question except I saw his hay.

What grain ration would you feed with corn stalks and oat straw now, to cows coming fresh in the spring?

Mr. Litchard.—Wheat bran, linseed meal and some ground oats. Cornstalks have a nutritive ratio of 1 to 17, so something must be fed to narrow the ration. These foods will do it.

About what per cent. of loss is there when feeding ripe whole grain to cows?

Mr. Converse.—I don't know just what the question means, unless it be unthreshed grains. As a rule, more feeding value may be gotten from ground grains; but I should mix it with the coarser fodder, as both are more easily and fully digested.

A Farmer.—I believe there is a loss of fully 50 per cent. in feeding such unthreshed grain, over that ground. If you had ensilage, sprinkle ground grain on it. We have fed it to horses during the last ten years, with good results. When I say ensilage,

I mean that made from matured corn and stored in a frost-proof, air-tight silo; not ensilage that is sour or moldy.

How large ration do you recommend for a good butter cow?

Mr. Baker of Schenevus.—Once we have a good cow, she should be fed all she will eat, assimilate and digest of good milk-producing foods, no more; if she is, the extra food will be thrown away. We should begin with the calf by feeding it properly, and the foods should be those that will stimulate the milk producing organs and thus develop them, else they will remain dormant, the milk-producing functions destroyed in part at least, and the calf be forced to lay on fat. When this course is pursued with the calf, the habit cannot be changed when cowhood has been reached.

Mr. Van Alstyne agreed with Mr. Baker, and said he had been breeding up his herd, with the view of producing butter fat and had got the herd up to 5 per cent. fat. That point having been reached, he did not want to go higher. He did not believe it possible to maintain a higher per cent. of fat and keep up the milk flow. As a rule, the Jersey breeders are looking after more milk and a little less fat; while the Holstein breeders are after less milk and more fat. If however, he can secure 7 per cent. cows together with a proportionate quantity of milk, when compared with good 5 per cent. cows, he was ready to invest in them.

Mr. Cass said he disagreed with Mr. Van Alstyne. He had cows that are giving a good flow of 7 per cent. milk; if he could get more than that, he wanted it.

Mr. Van Alstyne.—How many pounds of milk do your 7 per cent. cows give per day?

Mr. Cass.—I don't know; I don't weigh milk, I weigh butter; but they give enough milk to make 3 pounds of butter per day.

Can we afford to feed the cow on hay and grass alone?

Mr. Cook.—I would not want to feed the cow alone on either one, but I should want to see the hay. If there were a reasonable amount of clover in it, I think one could feed a full ration of hay. If you have no ensilage, about 20 pounds a day would be a proper feed. The question is a very indefinite one.

Hay is $11 per ton, mill feed $18; which had we better feed for butter?

Mr. Van Alstyne.—It would depend on conditions. If the cow is fresh in milk and is worth anything, and we want to make milk in winter, she certainly ought to be fed grain. Whether it would pay to feed grain in summer would depend on the pasture. If it was very short, and the cow a good one, it will pay in the long run to feed her some grain.

Should cows be watered directly after being fed?

Mr. Van Alstyne.—I don't think that will make much difference. If the cow wants water, she will drink it; if not, she won't. Nor do I think it makes much difference whether she has it twice or three times a day.

Mr. Cook.—Water a cow twice a day, and I believe that, if we can have the water pure and clean, the place to water the cow is in the barn; and, theoretically, the water ought to be at a temperature of 98 degrees, but the cow seems to prefer it at a temperature of 50 to 60 degrees. She ought not to be forced to drink ice-water, as she must eat an extra quantity of food to warm it up to the temperature of her body.

What ails the cows? In November the test was lower than in October; then higher in December. The rations were the same and the same person had charge of them.

Mr. Cook.—I don't know. Have seen the same thing in our herds and among the herds of our patrons. I can't answer the question.

What is the best early summer feed to grow for milch cows?

Mr. Converse.—I incline to the belief that ensilage is the cheaper. Very many farmers are building siloes for summer feeding. If you do not have it, grow alfalfa or oats and peas. Alfalfa is, perhaps, best, for, when you get a good stand, it will last a number of years, while from two to four cuttings may be made in a season.

Can apples be fed to milch cows, successfully?

Mr. Van Alstyne.—Yes; but I would begin with not more than four quarts of mature apples per day; then increase the quantity to a peck. The quality of the apples will depend somewhat on

the amount. They are of the most benefit when fed with coarse fodder, hay, cornstalks, straw or ensilage.

What is the best food for a milch cow in winter, and how much shall she be fed?

Mr. Cook.—It will all depend: First, what is the roughage, and what is the capacity of the cow. We should aim to feed that which will produce most at cheapest cost, and then, if we have a cow that will profitably respond, we should feed her all she will digest and assimilate. One cow will require more, another, less, and one cow will respond better to one ration than will another. The question implies an experiment together with the cost of the foods.

Wanted: A balanced ration for milk that will test 3.5 per cent. fat, using corn stalks, corn meal and oats?

Mr. Cook.—That might do, but, I think I would leave out the corn meal. Of course, it would depend very much on the quality of the corn stalks.

How about selling oats and buying wheat bran?

Mr. Cook.—I don't believe I would do it. We have had this thing somewhat overdone. I mean this advice of selling oats and buying bran. But it would all depend on the price of the oats and the quality of the bran.

Should a heifer persistent in milk be dried off before her second calf, having milked only 10 months?

A Farmer.—No; keep right on milking her.

Mr. Converse.—I do not believe a man ought to feed a cow with the intention of drying her off, nor should the grain ration be taken off for that purpose. But I would feed less grain and less roughage.

In dairying with four or five cows, which breed is the best to keep for butter and to raise stock for beef to be ready for market at two years of age? Would you keep Thoroughbreds or crosses, and what breed or what cross?

Mr. Converse.—I would not combine the two, nor would I cross two breeds. If I wanted milk, not butter, I would select the Holstein. If butter, I would invest in the Jersey or Guernsey,

both give milk rich in butter fat. But, do not invest in a general purpose cow; either go after beef or butter. If the latter, select a dairy breed.

For a family cow in a village, what breed or grade do you prefer?

A lady.—A Jersey cow is the one to invest in.

Mr. Cook.—I incline to the belief that the lady is right. If one wants a reasonable quantity of good, rich milk, the Jersey, I think, will fill the bill.

A voice.—How about the Ayrshire?

Mr. Cook.—As a rule, the Ayrshire gives a good flow of milk, in quality between the Holstein and Jersey. The average butter fat per cent. in such milk is not far from 3.5 to 4. But there are Jerseys and Jerseys. Some of them are very poor sticks, while there are some Ayrshires that are fine individuals and rich milkers.

Would a cow that was poor in flesh give poor milk?

Mr. Cook.—I am not going to say she would or would not; but if a cow is in her normal condition she will give normal milk. I have seen cows giving a large quantity of milk that was very rich in fat, yet they were poor in flesh. I saw one at the Geneva station that was giving 32 pounds of milk per day, rich in fat, but you would not want her in your herd.

At what age should heifers come in milk?

Mr. Eastman.—From 18 to 24 months, but there may be a difference in breeds; if, however, I could have it as I wanted I would have the time from 20 to 22 months; at that age she will do well and nearly fully develop by the time she is three years old. We want to develop the cow from the start, beginning early. We have one heifer that we milked 106 days before she was two years old, and she gave 20½ pounds the last day.

What would you sow for pasture grass where you plow up your pasture to kill out weeds, to have something fresh for your cows the same season, if you sowed it in the spring?

Mr. Cook.—I don't hardly know. Orchard grass is good when kept closely fed. Meadow fescues and the white clovers are also good. Orchard grass, if allowed to grow too large, becomes hard and woody. We have it eight years in one pasture, but it is kept

eaten down close. If I were to plow up my pasture to kill out weeds I would sow rye to feed early.

I would ask Mr. Converse if some breeds of cows will not hold out in their milk better than will other breeds?

Mr. Converse.—No, sir; it is not a case of breed, but of individuality. Some cows of a breed will hold out longer than will others, whether they be Guernseys, Ayrshires, Jerseys or Holsteins.

How does the cow secrete her milk, or give up or withhold butter fat?

Mr. Cook.—I don't know. The darkest place in the world, said Governor Hoard, is the inside of a cow. The nervous cow gives most butter fat and will withhold it more than will any other type.

Taking a good healthy herd of cows, feeding them good corn ensilage, 30 to 35 pounds each, daily, with two full feeds of clover and timothy, with a good grain ration of bran, oats and corn, say seven pounds of the mixture and three pounds of cottonseed meal, ought such a ration produce a good quantity of milk? What changes would you suggest, if any, to better the quality and quantity of milk?

Mr. Cook.—I should think that would be a very good ration indeed, but one ought to watch the cows and feed accordingly. The weak point in that formula is its cottonseed meal, the per cent. being pretty high.

Will it be profitable to feed ensilage in summer?

Mr. Ward.—Most assuredly. The time is close at hand when every man who keeps live-stock will have a summer silo. It is coming and will come to stay. I have seen ensilage three years old that was perfectly sweet and as good as new.

Does a mixture of peas, oats and barley make a balanced ration for cows giving milk in summer?

Mr. Converse.—I would leave out the barley.

Mr. Cook.—That would make a good ration, and I am of the opinion that it is not a good plan to begin balancing a ration in summer for the old cow till she has all she wants to eat.

A Farmer.—Would you feed a cow grain in summer

Mr. Cook.—It would depend on the value of the milk; but our practice at home is to feed some grain every day. We buy cheaply as we can, and get all we can for what we sell.

Which is the best time to feed grain to milch cows, before or after feeding fodder?

Mr. Gould.—It does not make much difference, but I prefer to feed it before; do not feed it while she is eating roughage; if you have not fed it before, wait till after you are through milking.

Does 60 or 70 pounds of ensilage, one of pea meal, three of bean meal and four of mixed feed, make a good ration?

Mr. Gould.—To guess, I would say there was enough protein in such a formula to balance the ration.

Does it pay to weigh and test milk?

Mr. Ward.—I believe that a man ought to weigh and test each cow's milk, so as to be able to weed out all the poor ones.

Mr. Jerry Clarke.—I had 11 cows which made me $100 worth of butter each, in a year. I also sold a pair of oxen for $300. They were Holsteins, too. One man here says that there is no such thing as a general purpose cow, but I know better. Mine not only brought me good results in butter, but calves also.

What effect will buckwheat bran have on a cow in calf?

Mr. Cook.—I would feed buckwheat middlings in place of the bran, but I would not feed them exclusively. It is better to add some wheat bran or gluten. Then too, the nature of the course fodder must be considered; the best of which, for such a cow, is corn ensilage if we are to feed these grains. We want to balance the ration, and, a cow in calf, must be fed so as to perfect the calf as well as to keep the mother in good condition; so, then, there must be protein to furnish blood and growth for the unborn calf, as well as for the mother.

What is the proper ration to be fed with timothy hay for butter?

Mr. Cook.—Timothy hay is a carbonaceous food and will not produce much milk, if fed alone. To get best results from it, one should feed the protein foods such has have been recommended here, viz., wheat bran, buckwheat middlings, gluten, linseed meal and oats and peas, always taking into consideration the individuality of the cow, then feeding accordingly.

What variety of grain is best to feed for milk and butter, for best results?

Mr. Litchard.—It would depend on the quality of the hay. Clover hay is much more valuable for feeding a cow than is mixed hay or timothy. Corn stalks left out till this season, have a ratio of 1 to 17. Bran and linseed meal would be the most profitable to feed with ensilage or hay. Eight to ten pounds of bran, three of linseed meal and 30 to 40 pounds of ensilage will make as good ration for an ordinary cow, as we can formulate. With clover, less bran and linseed may be fed.

Is rape a good food for milch cows?

Mr. Van Alstyne.—There is no question about the value of rape. It is, however, a sheep food; but it may be fed in a limited quantity to cows. If you want it for spring feed, sow it early in the spring. If for fall feeding, sow it in August, but it may be sown in the corn during the last cultivation for fall feeding. Dwarf Essex is a good variety.

What would be the result if rape were sown later than the last of April or first of May? Would such seeding last until fall?

Mr. Ward.—No; I would not sow it then for fall feeding. Forty-five days are time enough. From the 10th to the 20th day of June is early enough. It will then be ready to cut in August, while the little red louse, that attacks early-sown rape, will not appear. Sow the Dwarf Essex variety.

Is this a good ration for milch cows, viz.: 10 pounds of ensilage, 10 pounds of timothy hay, seven pounds of gluten meal, one pound of peas and oats?

Mr. Van Wagenen.—That is almost an ideal ration. It is a little wider than the German standard but is very nearly like the one the professor put on the blackboard, having a ratio of 1 to 5.9

When the farmer is depending on the factory, that runs but eight months of a year, and he only wants his cows to go dry two months, which two months are best for his cows to go dry?

Mr. Ward.—I would turn that question around and run the factory twelve months, if I could get a man to do it.

Mr. Converse.—The man will do it, if he can get the milk. We ought to produce more milk in winter than in summer; while

the same cow will give 1,000 pounds more milk during the year when she drops her calf in the fall, than in the spring, if she is well cared for and properly fed.

To Mr. Van Dreser.—How would you test the individuality of a cow?

Answer.—First, have her well, then feed her well. Feed a cow all she will eat, digest and assimilate, first finding if the cow will pay a profit on what she eats and the care she receives. You will ascertain her worth by the use of the scales and the Babcock test.

What is the matter with this ration: 15 pounds of timothy hay, five pounds of clover hay, four pounds of gluten feed, 15 pounds of roots and four pounds of bran?

Mr. Cook.—I see nothing the matter with it; it is, in fact, almost an ideal one, having a ratio of 1 to 5.4.

Shall we grind grain for cows finely or have it coarse?

Dr. Smead.—As a rule, fine, but, in oats, it is not necessary to grind the oat hull finely. If it is only crushed it will do, but the finer the inside or kernel is ground, the better. If you are going to feed ground oats to pigs, sift out the hulls, and the finer corn is ground, the better. Some animals, as a rule, do not masticate grains properly.

What is the best grain ration, with corn ensilage and hay, for the production of milk?

Mr. Cook.—Wheat bran or wheat middlings are as good if not better, all things considered, than any other foods. Gluten is a good food, but it does not contain enough mineral element. We are too apt to look for protein only; but the cow must have mineral matter. Gluten does not furnish it and I should not want to feed a cow enough cotton seed meal to give her the requisite quantity of mineral matter. If I remember correctly, there is four times the quantity of mineral matter in wheat bran as in gluten. But a mixture of wheat bran and gluten, half and half, with good corn ensilage, would make an excellent ration.

How about barley sprouts?

Mr. Cook.—Malt sprouts and wheat bran, according to the tables, contain the same per cent. of protein, making the figures

100 each, while H. O. dairy feed is figured at 103, gluten feeds 120, gluten meals 152, old process linseed meal 135, cotton seed meal 152, Buffalo gluten 125. These figures are on the basis of wheat bran at 85 cents per hundred pounds for the protein value. The starch foods on a basis of corn meal at say $1 per hundred are valued as follows: Corn meal $1, "Quaker Oat" feed 85 cents, oat hulls 75 cents, "H. O." horse feed 95 cents. I think we lose sight of one great point, that is, we are feeding the cow for the special purpose of getting milk and overlooking the most important ones of her health and that of her posterity.

Will Mr. Gould tell us what breed of dairy cows would be the best for a general-purpose cow, in his opinion?

Answer.—Why not ask what machine will do all the work on the farm. We cannot have a cow that will give a lot of milk one day, a heifer calf one year and a bull the next, and, lastly, beef, and have her a success. The farmer must use the best he has; then breed up. One man wants a Jersey, another a Guernsey and so on. Take the best you have got. Breed up and stick to them.

Will young cows do as well when standing beside old cows through the winter as they would if in separate stables?

Mr. Cook.—I do not know why they will not. We have both old and young cows standing side by side, and have had every year, but I never have detected any difference between them and those which were standing alone.

How long should a cow go dry?

Dr. Smead.—Just as long as she wants to. Don't strive to dry her off. Nature made her as she is. If she wants to give milk till she drops her calf, let her do it. I have a cow that has been milked every day during seventeen years, and her oldest daughter is owned by my hired man. That old cow has never been milked without eating a grain ration. The daughter is as persistent a milker as is her mother. The old cow gave 6,800 pounds of milk last year, testing from 4.8 to 5.2 per cent. of fat; and there has been no falling off in her milk flow during the last ten years. The old cow is a cross between the Jersey and Ayrshire.

Do you think it advisable to milk a cow right along like that?

Answer.—No. If I could have my way about it I would have her go dry about one month; but if you ask me why, I shall say "I don't know." But one thing is sure, the cow that milks right along and drops her calf every year, will not have milk fever. It is the big milker that goes dry awhile and is fed large rations of concentrated foods, which make a surplus of blood, or the one that runs in rich June pasture when she freshens, that has milk fever.

Two weeks before the calf is dropped, give the cow three-quarters of a pound of Epsom salts and a teaspoonful of powdered gentian. Repeat the dose every five days till after the calf is born. This medicine thins the blood and stimulates the liver so that it will not become torpid. This treatment is followed by my neighbors and have heard of but one case of milk fever in the neighborhood in eight years.

Mr. Converse.—I should never feed a cow to dry her up. If a cow has been bred to give milk the year round, it will be hard to dry her off. If, however, she has been bred and fed to go dry four months it will be hard to prevent it. But I should not fuss with a cow that wants to go dry four months; let some other fellow fuss with her; milk her right along, if she persists in giving milk.

Is it any particular sign that the digestive apparatus of a cow cannot find any particular element in a food because a chemist cannot do it?

Mr. Cook.—I don't know. But a cow will find in some foods that which the chemist does not. As a rule, however, the cow and the chemist agree. But the two differ in succulent foods. The chemist finds water; and the cow finds it, but gets a benefit from it that she could not from separated water. This difference the chemist cannot find. But, when the chemist and the cow are consulted as to the analyses of dry foods, such as gluten, bran or corn meal, they fully agree. June grass has a feeding value, which, if the grass were cut and dried into hay it would not have. The difference is caused by the water or juice in the grass being partly dried out. When this moisture has been dried out, the grass loses in feeding value, nor can it be restored by wetting it with

water. We all know that a cow will give a larger flow of milk on June grass than on any other food.

What would the offspring be, if a cow milked steadily?

Mr. Converse.—If I could control conditions I should milk a cow eleven months, but I cannot always do it, so if a cow is so persistent as to milk right along I let her do it. It is dangerous to dry off such a cow. The tendency would be that a calf from such a cow would be a persistent milker.

Mr. Cook.—I would not dry off such a cow; but I will say that our best cows are those which milk about ten months.

Does it pay to wet meal to be fed to cattle with water?

Mr. Cook.—I have made many experiments in feeding wet and dried grains, and am convinced that it does not pay to wet them.

A Farmer.—I wet the grain ration for my cows and am satisfied that it pays, for the reason that the cow does not waste so much by scattering it while eating.

Mr. Cook.—The cow will not eat a dry ration so ravenously as she will a wet one, besides, she will wet it sufficiently with saliva.

Which is the most profitable way a farmer can use his oat straw on a dairy farm?

Mr. Ward.—As Mr. Converse has said, oats cut at the stage when they have half turned to a yellow color, then cured and threshed, will contain a large feeding value when fed to stock; but, if left till they are fully ripe, the best use that can be applied to the straw is to use it for bedding in the stable.

Will it injure a cow to milk her all the year around?

Mr. Pingrey.—I prefer to have a cow go dry at least six weeks; except, perhaps, a heifer. I should milk a heifer as long as I could get a tea-cupful of milk from her. I have cows, however, that I can milk the year round, but I do not care to do it.

Mr. Ward.—What would you do in this case—I have a cow due to come fresh in less than three weeks that is giving two large milk-pans full of milk every day.

Mr. Pingrey.—Milk her.

Mr. Ward.—That is just what we are doing and shall keep doing.

Mr. Pingrey.—Some cows at such a stage of gestation give gargety milk. Should they be milked?

Mr. Converse.—Yes; if you stop, the cow will lose a portion or the whole of the udder.

A Farmer.—Would you stop milking a cow when she begins to "spring bag?"

Mr. Converse.—It would depend upon the quantity of milk she was giving. If the mess was large, I would not.

What is the comparative value of hominy meal and gluten feed for milch cows?

Mr. Van Alstyne.—I have not the tables with me, but I think that hominy is worth about $2 less per ton than is corn meal, while gluten is wholly a different food. One is carbonaceous, the other nitrogenous, so do not compare at all.

How much cotton seed meal would you feed, if any?

Mr. Cook.—Not to exceed two pounds; and I would feed it dry with the dry coarse fodders.

Do cows need a grain ration when in pastures? If so, what is best to feed?

Mr. Smith.—If there was all the pasture the cows required, probably they would not need any grain ration; but, as a rule, in the average pasture in dry weather the cows do not get enough to eat unless they wander about all day. When a cow does this she is not making milk, and must necessarily shrink her milk flow. The most successful dairymen I know to-day in this State feed grain every day in the year.

What grains would you feed?

Answer.—Wheat bran and cotton-seed meal; but I would not begin with more than half a pound of cotton-seed meal and would not feed more than a pound of it per day. It is a concentrated food and must be fed judiciously.

Dr. Smead.—Oats and peas would come in very well for such feeding. Buckwheat middlings are a good food, but they make a poor quality of butter. Besides, their manurial value is not

very great; much less than in some of the other protein foods. The manurial value in buckwheat middlings is mostly in the nitrogen, the whole being $5.16 per ton.

Are roots equal to grain for producing milk and butter?

Mr. Litchard.—That is a hard question to answer. Both are necessary. The value of roots is found in their succulence, and if one does not have ensilage, he should provide roots for the cows. Their value is more in the aid they give to digesting other foods than in the food itself.

How often would you advise the salting of cows?

Mr. Cook.—Keep salt where the cow can have free access to it. She will not eat it except when she craves it, nor take any more at a time than she wants.

How much grain should a heifer one year old be fed with hay and ensilage?

Mr. Cook.—It would depend on the heifer. As well ask how many buckwheat cakes a man ought to eat in the morning. Possibly a pound of bran and oats, or some buckwheat middlings might be added.

How can the best ration be made at this time of year for milch cows (February 1st)?

Mr. Converse.—Special relation should be made with the coarse foods. Feed ensilage at night and morning—about 20 pounds each; feed at noon some clover hay. The grain may be bran, oats and peas or gluten meal, to furnish protein. If you do not have any ensilage or clover, but timothy or mixed hay instead, a little corn meal may be added to furnish starch and sugar.

What is the difference between a gluten feed and gluten meal?

Dr. Van Slyke.—I think the per cent. of protein in gluten meal is between 35 and 40. That in the feed, somewhat less. A bulletin issued by the station will give the figures. You may get the bulletin by asking for it. If you do not get it, it will not be our fault.

Mr. Dawley.—Cornell has also issued a bulletin—No. 154—giving all the analyses of these foods, as well as others.

How often should cows be fed during the day?

Mr. Cook.—Well, I am inclined to think that twice a day for both ground and coarse food is enough. Such a practice has given just as good results with us as has feeding three times, but we must feed uniformly; not twice to-day, three times to-morrow, and four times the next day.

Does it pay to grind the corn-cob to feed?

Dr. Smead.—No; but it will pay to grind the corn and cob together, the cob being ground finely. Best results will come from mixing it with wheat bran, there being a little fibre in the bran, which the animal seems to require. I use an iron sweep power mill, and grind my corn and cob together, doing it finely.

At what age should a heifer begin to breed?

Mr. Cook.—I don't know; but if I should tell you that 50 of our best cows now in milk, dropped their first calf at three years, you might consider me as heterodox. Yet such is the case; but the cows are magnificent Holsteins. One will have to study the animal and breed. If the cow comes from a breed or family that were bred to drop their first calf early, I would allow her to do it. As a rule, however, I prefer to have the young heifer become matured before she becomes a mother.

Does it pay to feed cows grain this time of year (November 25th)? If so, how much?

Mr. Henry Stevens.—It would depend somewhat on the condition of the cow, whether she gave a little or a good mess of milk. I think, however, at the present prices of butter and cheese that it will pay.

Mr. Farrington.—My father always said, "Feed the cows grain in the fall of the year."

Mr. Cook.—I don't like this idea of talking about feeding a cow, now. We want to feed a little grain all the time. If we do not feed till now, the chances are the cow will put it all on her back. I have known instances where a ton of bran was fed and not a cent of it was gotten back. We feed some grain all the time.

What is the value of the proprietary cattle foods compared with gluten?

Mr. Cook.—"Sixteen to one." Gluten is sixteen; the other not more than one. The basis of all these prepared foods is linseed meal, costing about $30 per ton. There is a little tonic and salt, which cost but little, while the preparations are sold for about $300 per ton to the man who is fool enough to buy them.

Dr. Smead.—Mr. Cook's remarks apply fully as well to the condition powders sold. They have a basis of linseed meal with powdered gentian, saltpetre, ginger, charcoal and anise seed. The cost of 100 pounds of the above mixture will be about $2.85, but the man who comes along to "bless you," sells it for about 15 cents a pound, or $10 profit on 100 pounds of oil meal.

Are we taught that a cow giving six quarts of five per cent. milk would make no more butter if she gave 12 quarts of milk?

Mr. Smith.—You are not taught anything of the kind; but that a cow in normal condition giving 5 per cent. fat cannot be made to increase it; but as a cow increases in lactation she shrinks her milk flow, so there would seem to be more fat in the milk. In fact, there will be, but the water has been decreased, so that there is not such a volume of it.

Will bran produce as good quality of milk as will corn meal? Will good strong heavy foods produce better milk than light ones?

Mr. Cook.—Doubtless, the question refers to feeding butter fat into milk. How many of you think it can be done?

Four men voted.

How many think it cannot be done?

Twenty hands went up.

Mr. Cook.—Some of you voted twice, but the majority are right. It cannot be done permanently. I have, however, changed the per cent. of fat in milk by changing a ration, when the cow had not been kept up to her normal condition. Perhaps a change of rations might decrease the per cent. of fat. As a rule, the longer a cow is in lactation, the richer will be her milk, but the flow will be proportionately less. It is a decrease of water, not an increase of fat. If corn meal is fed to excess, the chances are that there

will be a decrease of fat in the milk and an increase of animal fat, for the reason that corn meal contains but very little of the milk-making element. It is highly carbonaceous, and does not contain protein enough. We must feed the cow that which will make blood. Corn meal will not do it. When you kill a hog that has been fattened on corn only, how much blood do you get when he is bled?

A Farmer.—Not much.

Mr. Cook.—The same is true when a cow is fed wholly on timothy, corn, corn meal, cornstalks or straw. If the latter-named coarse foods are fed, take out all the corn meal and substitute bran.

Will skim-milk, fed back to a cow, produce good milk? Do you recommend such a course?

Mr. Cook.—How many of you feed the skim-milk back to your cows?

A Farmer.—I used to feed it to pigs, but have been feeding it back to the cows a year or more, and am convinced it was better to give the pigs away and feed the milk back to the cows.

Mr. Litchard.—Mr. Menzo Wilcox of Otsego county, one of the best dairymen in central New York, feeds all his skim-milk back to his cows, and reports it worth 20 cents per hundred pounds for that purpose.

How shall we best keep uniformity in a herd's milk through the year?

Mr. Cook.—We must first have a herd of persistent milkers and there must be some cows coming fresh every month. With such a herd, properly cared for and fed, there ought not to be a variation of more than two-tenths of one per cent. of fat; I know of no other way to do it.

Which is most profitable, at the same price, to buy, bran from winter or spring wheat?

Mr. Van Alstyne.—I do not think there is so much difference between winter wheat and spring wheat bran, as there is in samples of each. Some bran is poor stuff, and very much of the mid-

dlings which we get is nothing more than bran reground. As a rule, however, the brans are not very badly adulterated. The new feed law does not include them. But don't buy any of the oat foods, cotton-seed meal, linseed meal, pea meal, starch feeds, malt sprouts and many others of similar natures, unless a guaranteed analysis is furnished by the miller or dealer. If you ask for them he must put the tags on the sacks, on which is printed such guaranteed analysis.

What is the best tie stanchion or stall for the cows?

Mr. Cook.—There are a good many best stanchions. Much has been said against the old rigid stanchion, and yet it has its advantages. We have come down to a swing stanchion, which we make ourselves, and will put into our new barn.

A drawing of it was shown and explained. Mr. Cook said the stanchion would be made of elm, and, as made at home, would cost, all told, about 60 cents each, in bunches of 25 or 30 sets. This does not include the work of putting it in place.

Mr. Smallwood.—We buy such stanchions here, in place, for about $1 each. I have discarded the Bidwell stall, having made up my mind that I could better afford to lose a teat or two from a cow by the one standing next to her, than to keep a man about to keep the stalls in repair.

Which is the best way to bring cows from the pasture at night, a dog or with a handful of meal?

Mr. Converse.—I would not bring the cows to the stable with corn meal, but wheat bran instead.

How much grain should be fed a cow fresh in milk, for profit? How much corn and shorts, at $20 per ton, will it be profitable to feed a cow that has of hay all she will eat, with butter at 20 cents per pound and how much of each?

Mr. Van Alstyne.—I will answer these two questions in one. But I will first say that the two foods—hay and meal—will not make milk, while the shorts will. It would depend first on the cow; next, on the coarse fodder. I should first want to see the cow. She may be one that it wouldn't pay to feed a pound of

grain to, because she would not respond in the pail. When you have a cow that will, feed her all she will eat, digest and assimilate. If you are feeding timothy hay, cornstalks, ensilage, straw or other fat-forming foods, she will not require so much corn meal. If the hay is clover and you do not have well-eared ensilage, she will require more meal. As a rule, from six to twelve pounds of mixed grains will be enough for any ordinary-sized cow, say, weighing 1,000 pounds. There is another point to be considered, which is the price of grains, also the price of the cow's product. We should keep an account of the prices of foods and products, and aim so to feed as to obtain the desired production, at the same time derive a profit at the market price of butter, cheese or milk. With my dairy, if they give me 300 pounds of butter per cow, at present prices for cow foods, I can clear a profit from butter at 18 cents per pound.

Which has the most feeding value, oat or buckwheat straw?

Mr. Cook.—I think the oat straw is a little more valuable, but there is a great deal of feeding value in buckwheat straw when it has been well cared for. As a rule, buckwheat is put up in too small shocks. It were better to set two or three of them together and then put the straw under cover.

What is the nutritive ratio of bran, compared with oats?

Mr. Litchard.—Bran has a nutritive ratio of 1 to 4. Oats 1 to 7 or 8.

Rations for cows in milk, two feeds of hay per day—How many pounds of cotton seed should be fed to balance the ration?

Mr. Cook.—I would not feed the cotton seed. Would much prefer gluten. It has a large per cent. of protein in it and is not so concentrated as is cotton seed. Wheat bran and buckwheat middlings should be mixed with the gluten, to furnish mineral matter which the gluten does not contain. But gluten meal, in comparison with other protein foods, cost a little too much. When When buying these foods, always take into consideration the pro-

tein value. I would not feed cotton seed no matter how cheaply I could buy it. I would much prefer linseed meal to it.

Dr. Smead.—Put in a word for oats and peas.

A Farmer.—How much shall we feed of them?

Mr. Cook.—I don't know. It will depend on the cow. No two would require the same quantity. Experiment with the individual cow, and feed so as to have her respond. Palatability of the food should also be considered.

Which is the best grain ration for a cow that is a good milker, equal parts of oats and wheat bran (by measure) or corn, oats and bran, with mixed hay, corn stalks and bean pods for roughage?

Mr. Cook.—Wheat bran and oats. Wheat middlings are a good food, but I prefer the bran. The cow needs mineral matter, which the bran will furnish. There is a little less digestible protein in the bran than in the middlings; still, all things considered, I prefer the bran. There would not be much difference in the analysis of the two rations, however.

To Mr. Converse.—What do you think of the Ayrshire cattle for this country?

Answer.—I do not care to say much about the Ayrshire, because I am interested in them. But I will say that, if one wants a hustler and has rough, hilly pastures, where a cow must work to get her living, there is none better. They give a good flow of good milk, being about midway between the Holstein and Jersey. They are also strong, healthy and hardy.

What do you think of the old milking strain of Shorthorns?

Answer.—It was a great mistake when they were allowed to go out. It was a most excellent dairy breed. When the breeders abandoned milk for beef in the Shorthorns they practically ruined the breed for dairy purposes.

Are the Devon cattle a profitable breed for the average farmer?

Answer.—I found at several fairs last fall that some breeders were trying to make a dairy cow out of the Devon, but it is more

essentially a beef breed. I take but very little stock in the Devon as a dairy cow.

What do you know about the Brown Swiss cattle?

Answer.—There is a herd of Brown Swiss near me. I have been watching them a number of years, and do not like them. They are too beefy, and are not fashioned after the dairy form in cows. They have short, thick necks, large legs and feet, and are devoid of some of the most prominent features always seen in a purely bred dairy cow.

Are there two separate breeds of Shorthorn cattle?

Mr. Van Dreser.—The first importations of Shorthorns were of the milking strain. Another was made of the beef type, and the breeders sought beef more than they did milk, so that the dairy Shorthorn has been about driven out.

Mr. W. S. Moore.—There is also a type of polled Shorthorns, but they are beefy.

Mr. Van Dreser.—I would not select any type of Shorthorns now for a dairy herd; but they will be found one of the best beef breeds.

What is the best breed of cow to be got, and where can it be obtained?

Mr. Cook.—That would depend. If I were going to furnish milk to this milk station down here when they get it built, and they paid alike for all grades of milk, I would get a cow that would give a washtub full if I could find her. If, however, I wanted it for butter I would select the Jersey or Guernsey, and I believe the modern American Jersey the best; I mean the large, strong Jersey, one that weighs 1,000 to 1,200 pounds; especially for butter-making, is the best. We have a large herd of Holsteins, which give good flows of milk, ranging from 3.2 to 3.6 per cent fat, and I have also been investing in some Jerseys, with the view of ascertaining, if I can, which breed will make a pound of butter fat the most cheaply. If your creamery here takes milk by the Babcock test, and your milk tests much above 4 per cent., stick to it. If below 4 per cent., say 3.6, sell it to the station. As a rule, how-

ever, the price of milk at the station is just on a par with that at the creameries and cheese factories. The stations never put up the price for milk till the price of cheese and butter goes up, and they always drop the price as soon as those of butter and cheese drop.

Will it pay to sow rape in corn for fall feed for cows?

Mr. Van Alstyne.—Yes, sir; but I would not sow it for fall feed for cows that give milk, because the milk would be condemned. But for cows not in milk, or for sheep, it is a good food. Sow it in August or in September. It will remain green a long time after the frost comes. Sow it in corn, not with oats.

Are vetches valuable as a green food for cows?

Mr. Van Alstyne.—It makes a clover crop sown late in the fall, but the seed costs so much it makes it expensive. Sand vetch is said to be the best.

I have 10 fresh cows in milk, giving 300 pounds per day. Grain rations of gluten bran or buckwheat middlings, costing 12 cents per cow, all they can be made to eat. Can the ration be improved?

Mr. Cook.—I don't know whether it could or not, with the present food at hand; but with some succulents—ensilage or roots—I think it could. It would also depend on the time the cows had been in milk and their condition and the freshness of the hay. I think, however, that the ration as given would be pretty narrow.

The Questioner.—The ration costs about twelve cents per day.

Mr. Cook.—The cow will have to keep herself warm by burning up some of the protein in her food. I would feed a little more starch. It is just as expensive to feed a too narrow ration as one too wide; would add corn meal, which would not add to the cost; it should be cheaper.

What proportion ought corn meal and bran to be fed to milch cows to give best results?

Mr. Cook.—It would depend on the cows and the coarse fodder. As a rule, however, with clover hay, half-and-half by weight will be about right; yet some cows would require more of the bran or

meal than others. With clover hay more corn meal may be fed than if the hay were timothy or mixed.

What should be the proportion of corn meal, bran and cotton seed meal, with hay, for a cow weighing 1,000 pounds?

Mr. Cook.—I would not feed more than two pounds of cotton seed meal to a cow per day. It is too constipating in its nature. I should feed oil meal in its stead.

At what season should a cow freshen to give the most milk during a year?

Mr. Eastman.—In September or October.

Mr. Gould.—My experience is that the same cow, coming fresh in milk in the fall, is good for 1,000 to 1,500 pounds more milk than when she freshens in the spring.

Mr. Eastman.—There would be a slight loss at first when the change was made, so I would have the heifer freshen the first time in the fall.

To Mr. Van Dreser.—What is the record of Pauline Paul's heifers?

Answer.—I cannot answer the question fully. I think, however, that Mr. Reed of Binghamton, has one of her daughters which has made 30 pounds of butter in seven days. There are others, which I have heard, are good producers. So far as I have heard, Pauline Paul's sons are more prominent than are her daughters.

What kind of stall or fastening is best adapted for the ease and comfort of the cow?

Mr. Van Wagenen.—We use the swing stanchion. There are several others and there may be among them some that are better. I would not use the old, rigid stanchion, and I believe that any one of the ties is better than the swing stanchion, because they permit a cow to turn and lick herself, something she cannot do either in the old rigid or the swing stanchion. Mr. Dawley uses a chain and long staple. It is the best I ever saw.

When shall we feed turnips or cabbage to milch cows, before, after or during the milking process?

Mr. Cook.—After milking, and do not feed too much at first. Begin with a small mess, which may be increased gradually. I once saw butter in Cortland that was made from milk from cows which had eaten large rations of cabbage every day. But such foods should be fed after milking time, should be balanced with nitrogenous foods, and one should always thoroughly cool and aërate the milk as soon as it is drawn from the cow. If they are fed during the process of milking a taint will surely get into the milk, so strong as to affect the flavor of the butter.

A Farmer.—What if a man has but little hay, but plenty of oat straw? What, then, should he feed?

Mr. Cook.—I should feed wheat bran and a little cotton seed meal. It makes a good ration. Good oat straw is about as valuable for feeding as is the average timothy hay. We are going to feed it this winter, but our oats were not left until thoroughly ripe before cutting them. Pea straw is also good; so is buckwheat straw for feeding, when fed with proper grains. Good timothy hay averages a nutritive ratio of 1 to 15; oat straw, 1 to 25; but I take the ground that early-cut oat straw is fully as good as late-cut timothy. But we are apt to classify all meadow hay, except clover, as timothy, when, perhaps, a large part of it is mixed grasses. I found, while in Delaware county, that the farmers were invariably feeding their cows some corn meal, although their meadows were classed as timothy. But I found that they were mixed grasses, which were cut early; therefore they did not contain enough carbohydrates, which was the cause for feeding the corn meal. Such meadow grass will have a ratio not wider than 1 to 12 or 1 to 14.

Are the Guernseys as large milkers as are the Ayrshires?

Mr. Converse.—No; they give, as a rule, milk containing more fat than do the Ayrshires, but not so much of it during a year. The Holstein and Ayrshire breeders have been and are now looking for a less flow of milk with more fat in it; while the Jersey and

Guernsey breeders are looking for more milk. As a rule, the cow that gives very rich milk gives a small flow, although she may remain in milk a long time; while the cow giving a large flow puts less fat into it. It is the tendency of these two extremes to come closer together.

Can a Holstein cow that gives 9,000 pounds of milk per year be made to give five per cent. milk?

Mr. Smith.—I don't know. I guess it would be pretty hard work. But there are some very valuable Holstein cows, those which give 4 per cent. milk. The average Jersey cows do not give more than 4.5 to 4.8 per cent., although there are many which give a much higher per cent. As a rule, the cow which gives a large flow of milk does not put in so large a per cent. of fat.

How does Pasteur's stock food compare with other stock foods?

Mr. Smith.—I don't know anything about that particular variety, but I suppose it belongs to the general line of these foods. They are composed of linseed oil, meal and salt, with something to make them smell well, and a little tonic. They cost from $25 to $30 per ton, and are sold to the farmer in small lots at $300—a good business for the manufacturers, but a poor one for the farmer who buys them.

What is the value of sugar-beet pulp to feed cows?

Mr. Cook.—They are experimenting with sugar-beet pulp in feeding a bunch of steers at Cornell, but no results have been published as yet. Prof. Wing says that they are quite well satisfied so far, as compared with ensilage, but it is not yet safe to quote a price for it.

What does gluten feed cost at the experiment stations?

Mr. Cook.—I do not know just now what gluten feed is quoted at in the market in car lots.

Mr. Van Wagenen.—At Cobleskill, last week it was $18.50 per ton.

Mr. Cook.—The new cattle food law which Mr. Witter got through the legislature last winter will go into effect the 1st of January, when all prepared cattle foods will be sold on a guaranteed analysis. So, then, if you buy gluten, mixed, or other prepared cattle foods after that date, insist on a guarantee. If the dealer refuses to give you one, and sells his goods, he may be prosecuted and fined.

Which has the most feeding value, barley straw or oat straw?

Mr. Cook.—There would not be much difference, provided both were cut at the same stage of ripeness. As a rule, our grains are left till too ripe before cutting them; then we lose more or less of the feeding value in the straw.

Will the feeding of such food as turnips or cabbage during milking time, taint the milk?

Mr. Litchard.—I guess there is no doubt that such foods as turnips and cabbage, if fed during the process of milking, will taint the milk.

Mr. Cook.—The trouble, as a rule, lies in feeding too much. Instead of feeding a few quarts at first, a half bushel or more is fed. If, however, one begins with a small quantity and increases it slowly, a much larger quantity may safely be fed. Prof. Wing determined this fact, through a number of experiments. But I would not feed impure foods of any kind, such as rotten potatoes, turnips, cabbage or apples, to any cow.

Do you consider it at all advisable to allow a Jersey or any other breed, to come in before she is two years old?

Mr. Van Dreser.—It would all depend on constitutional vigor. As a rule, I would not prefer to have a heifer drop her calf before she was two years old. But there might be one of some breed that was strong enough to withstand the strain on her system.

Is it a fact that an average Jersey cow will give more for the food consumed than will any other breed?

Mr. Van Dreser.—According to the Chicago test it required less feed for the Jerseys than of either of the other two breeds there,

the Guernseys and Shorthorns. There is no one dairy breed above another, in every respect, and the man who is such a breed partisan as to think his breed better than all others, makes a serious mistake.

What breed of dairy cows would you recommend for the farmers of Centerville and vicinity? Our cheese factories all close in November and do not open till April, generally.

Mr. Converse.—What breed of cows do you have here?

A Farmer.—Every breed and grade.

Mr. Converse.—The first step in the line of improvement should be by the selection of a full blooded sire. Select one from a dairy breed and select the breed that, with your feed, care and conditions, will produce a pound of butter fat for the least money; and, if it is a breed that came from Europe, give it as nearly as possible the care and food it had in its native home. If you select Jerseys, give them Island of Jersey care; if the Holstein, such care and foods as it receives in its Holland home. Never use a cross-bred or native sire; but, in selecting a sire, do not be governed by pedigree alone. There are thousands of them that do not amount to a snap. Don't bank on pedigree, but make performance the test. Pedigree is all right in a certain way, but it must be backed up by performance of ancestry at the pail. When you have such a sire, test with scales and Babcock each one in the herd. Select the best ones and begin breeding for a special purpose, which should be milk and butter. Do not undertake to run a dairy with dual-purpose cows. Beef and butter do not have a home in the same carcass. Either one or the other should be sought.

What is the best root to grow for milk production?

Mr. Hartley.—All in all, I find mangold's the best root to grow for that purpose.

Mr. Van Wagenen.—I think that Indian corn is the best "root" to grow.

Mr. Cook.—I do not grow roots, my back not being calculated for that business, but I believe it pays to grow and feed them, even if one has ensilage.

Will it pay the farmer to cut his hay and straw for feeding to his horses and cattle?

Mr. Van Wagenen.—Our system is to cut all the straw with the hay, feeding three times a day with the ensilage and grain all mixed. In so doing we are able to get rid of something that is not worth much to feed alone and is too good to waste for bedding our animals. We use steam power and a 16-inch cutter.

To Mr. Converse.—What is the difference between the Jersey, Holstein and Ayrshire breeds?

Answer.—The Jersey came from one of the channel islands and gives milk richer, as a rule, in butter fat, than does any other breed. The Holstein comes from Holland and gives milk containing the smallest per cent. of butter fat, of any one of the dairy breeds. The Ayrshire comes from Scotland and is a medium between the other two breeds.

Will it pay to feed the average cow $18 bran?

Mr. Powell.—I guess it would be an even race. The average cow brings an income of about thirty dollars per year. I find the average in several counties to be about that figure. Such a cow will not pay for much bran at eighteen dollars a ton.

With bran at $18 per ton, corn meal at $19 and hay at $11, which is the cheapest cow feed, and in what proportion should each be fed?

Mr. Cook.—I know of no way by which to compare corn meal and wheat bran. They are entirely different. If you have corn ensilage or timothy hay, it would be the height of folly to buy corn meal. If you have neither the ensilage nor timothy, but clover, then put in some corn meal. But I prefer good wheat middlings to the bran. It is not right, theoretically, but I have noticed that when I substituted them for the bran, the cows invariably gained in their milk flow.

How is milk secreted? Is it secreted in the udder. If not, where?

Dr. James Law.—Milk is secreted in the udder, the process being, as in other glands, a selection and transformation of the appropriate constituents of the blood by the microscopic cells

which line the ultimate recesses or follicles in which the milk ducts originate. Each of the smallest milk ducts terminates in a cluster of slight dilatations or closed sacks lined by round cells which accomplish the work of selection from the blood and transformation of the materials which go to form the milk. Beneath this surface pavement of cells, is a delicate membrane, and beneath that the network of capillary vessels in which the blood circulates. In health, therefore, none of the blood can get into the milk ducts, except such as has been passed upon by the secreting cells and modified as may be necessary, to form the liquid known as milk. The constituents of milk are in the main, water, salts, albumen, casein, fat and sugar, and of these the water, salts and albumen are the only ones that exist ready formed in the blood. The elements that give to the milk its commercial value—the casein, the butter fat, and the sugar—are made up in the udder, by the functional activity of the gland cells.

Is the color of milk changed from red to white before it reaches the udder?

Dr. Law.—No; the milk as such does not exist before it reaches the udder. Healthy milk is never red, and it only becomes so by reason of some unnatural condition such as:

a. The escape of red blood globules or of blood coloring matter through the walls of the gland follicles or milk ducts. This may occur from wounds, bruises, conjection or inflammation of these parts, or from diseased conditions of the blood in which the coloring matter is set free.

b. The feeding upon red coloring matter such as madder, which escapes with the milk into the udder follicles and milk ducts.

c. The presence in the udder and milk ducts of a pigment-forming microbe, like the *micrococcus prodigiosa*, which produce a red color in its growths.

Is there a visible connection between the milk veins and the udder?

Dr. Law.—The term *milk veins*, usually applied to the superficial abdominal veins, has misled a good many people and led them to suppose that those vessels convey milk to the udder, and

that therefore the larger the veins the greater will be the yield of milk. As we have already seen, the milk is not ready formed in the blood; it cannot be said, therefore, that these veins convey milk. These veins have, it is true, a visible connection with the two anterior quarters of the udder, from which they return blood toward the heart. But like the other veins of the udder (the external pudic, and obturator) these only carry blood back from the udder to the heart, they don't bring any blood to the udder. Their connection with the udder is that of vessels which carry back into the general circulation, the blood which has already, in the udder, given up various of its constituents to form milk, not that of vessels which carry to the udder the materials out of which milk has to be formed. Their size in heavy milkers indicates that a very large quantity of blood circulates through the udder, so that even its unused surplus requires such capacious vessels to carry it back into the general circulation. The great size of these veins further indicates that the whole circulatory system is constructed on a large and generous scale, and that there is a great store of blood, and behind that a great power of digestion and assimilation, conditions that are absolutely essential to a liberal yield of milk. In this way the size and even the duplication of the milk veins become valuable indications of the probable milking qualities, though they convey neither milk nor blood to the mammary gland.

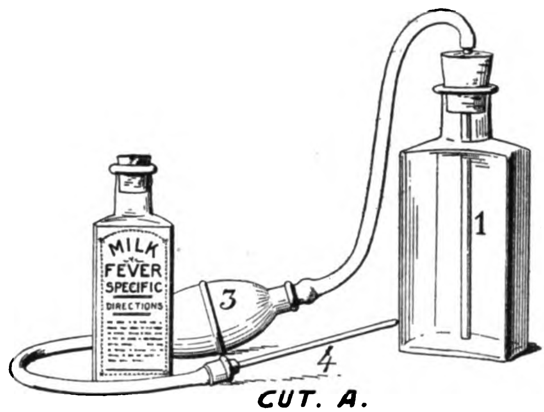
What is the Schmidt treatment for milk fever? Is it a sure cure?

Mr. Dawley.—The Schmidt treatment has not been in use long enough to say that it is a *sure* cure. I have tried it in one case, with a home-made apparatus and saved the cow. The reports in relation to the results from the treatment are most encouraging, it is based on an entirely novel idea as to the primary seat of the disease. Heretofore the veterinarian's attention has been directed to the uterus (womb), as being the medium through which the poison was admitted to the circulation and carried to its secondary seat of operation (great nerve centres) where its death-dealing depression was exhibited, and although very vigorous efforts were

pursued to combat its further introduction into the system, and counteract the evil effects produced, the results attained were at best most unsatisfactory and discouraging.

Without attempting to enter upon lengthy details regarding the malady, we may state that the result of the new Schmidt treatment coupled with close observation along experimental lines has demonstrated beyond all doubt that in the udder is the original seat of the disease. Decomposition of the secreting cells in that organ when the milk secretion begins, immediately after calving. A loucomaine (depressent poision), being formed from the cholesterin bodies and rapidly absorbed into the circulation is the direct cause of the disease. Why Prof. Von Kolding turned his attention to the udder we are not told, but since attention has been thus directed, various interesting and highly instructive experiments have been tried and it has been clearly demonstrated that decomposing milk injected into the udder at any time, produces within from twelve to thirty-six hours conditions identical with those of milk fever in the usual way, and post-mortem examinations point out almost identical abnormalities with that of milk fever, especially when the duration of sickness has been brief, proving conclusively that milk fever can be induced.

Treatment and Mode of Application.—As the symptoms of a well-marked case of milk fever are already well known to experienced dairymen, we deem it unnecessary to repeat them fully. When a good milking cow in high flesh just before or soon after calving becomes restless, paddles with her hind feet, lies down and rises with difficulty, the udder becomes soft and flabby, it is time to become suspicious that all is not right and immediate action should be taken. The herdsman, already provided with three sixty-grain doses of potassium iodide, carbolic acid and udder syringe of proper design, procures a liberal supply of freshly boiled water. The udder and teats should first be well bathed with warm water to which has been added a tablespoonful of carbolic acid to each quart. All milk should be drawn from the udder and one drachm (sixty grains) of potassium iodide should be dissolved in one quart of hot water (freshly boiled), with one dram carbolic acid, and in-



Parturient Apoplexy.

Fig. A. Instrument for administering Schmidt Milk Fever Treatment

Fig. B.—Instrument as it appears in the hands of operator.

jected into the udder through the teats—an equal quantity into each teat. The patient should be kept dry, warm and free from excitement or noise, and in no consideration should drenching be done so long as any acute symptoms are present. The patient should be turned from side to side every four hours, taking care to avoid injuring the udder, and the udder injection given again in six hours, if signs of return to consciousness are not present.

In the hands of European veterinarians reports come to the effect that 90 per cent. of 412 cases so treated made complete recovery. Various doses were experimented with, varying from one-half to two drachms of the drug, and although the smaller dose was repeated at shorter intervals the one drachm doses gave best results, while a double quantity producing alarming symptoms and did not appear to exert any more favorable influence over one-half the quantity, which appears perfectly safe.

How Does Potassium Exert Its Influence in Such Cases?—Long before potassium iodine was associated in this way in the treatment of milk fever, it was a well established fact that it exerted a stimulating influence upon the base of the brain and great nerve trunks when administered in large doses, and it is in this action that it counteracts the depression present in that malady. It also, no doubt arrests the decomposition in the udder when brought into the direct contact with the udder content. Having a powerfully stimulating effect upon the lympathic glands, it also hastens the elimination from the system of the offending poison.

Form of Instrument Most Suitable for Its Application.—Various instruments have been recommended for the application of the udder injection, but the instrument portrayed in the accompanying cuts seems to fill the greatest number of requisites with fewer objectionble features than any other we have seen. (See cut A.) The large glass bottle, No. 1, holds the required quantity (half pint) for one quarter (one teat). This bottle can easily be cleansed. It can be brought to the proper temperature by immersing in hot water for a few minutes previous to its use. The rubber tube (2) is connected over the end of a glass tube which runs to the bottom of a glass bottle (No. 1), thus minimizing the danger of air being

pumped into the udder with the solution. The remaining portion of the instrument consists of a bulb syringe (Fig. 3) to which is attached a milking tube (4) which can readily be detached for the purpose of cleaning, previous to inserting the silver tube into the teat. The bottle (No. 1), should be filled with the prepared solution at 102 degrees F., and the syringe pumped full, which also forces out the air, and as soon as the contents of the bottle (No. 1) is emptied, the operation of the bulb should cease, so as to avoid the introduction of air into the udder, as air hastens decomposition and thus delays recovery. Great caution is also necessary to avoid the introduction of foreign substances, hay-seeds, etc., which may drop into the vessel containing the medicine, as such will produce damaging results upon the udder. Everything must be kept scrupulously clean to secure the best results. Cut B shows the instrument in actual use with the tube inserted into the teat and shown in the correct position in the hands of the operator.

Can the cow be given any treatment previous to parturition that will prevent retention of placenta?

Dr. Smead.—Before answering this question direct, it may be well to call attention briefly to the generative organs of a cow. On the lining membrane of the uterus may be found from 50 to 100 protuberances, or lumps, in farmers' parlance; after the cow becomes pregnant and a membrane or skin is formed about the embryo calf, a similar lump or protuberance is formed on this membrane adhering to the one on the membrane of the uterus. These, in both cases, are called cotyledons. It is through their adhesion that the calf is furnished nourishment in its fœtal life from the blood of the mother; when there are perfect normal conditions. Soon after the calf leaves the uterus, nature, true to herself, breaks loose these adhesions, and the placenta or after birth—another name for what farmers call the cleanings—is expelled from the uterus as it then has accomplished its office work in the development of the fœtus. We thus see that the retention of it beyond from twenty-four to forty-eight hours, is due to some abnormal

condition. It is, therefore, our study to determine what those conditions are, and what will overcome them. First, the cow may have a protracted labor and there is exhaustion of the uterus and total lack of after or secondary labor pain, and the placenta remains in the uterus simply because the uterus has not the power to expel it. The veterinarian would in that case give a dose of ergot; but a farmer had better use a more safe and just as effectual a stimulent, that is a gill of whiskey and a tablespoonful of good ginger mixed in a pint of warm water (being sure to give the whiskey to the cow as well as the ginger). This can be repeated in from four to six hours. If labor pains are produced and the placenta is not expelled, there are good reasons for believing that the adhesions have not separated and no uterine stimulant will cause expulsion. In cases of that kind I have observed that there is always present a dry and fevered condition of the uterine membranes. It is largely through aluminous mucus that these adhesions are broken loose, and when there is a lack of this mucus (due to a fevered condition), the remedy should be to supply it as far as possible, and that can best be done by giving the cow laxative drinks and mashes, like flaxseed tea; an ounce of gum arabic can be dissolved in two quarts of warm water and injected into the uterus with a proper syringe. But the question calls for a preventive; yes, that can be furnished by keeping the cow in a normal condition during the year, or rather year in and year out. One abnormality calls for and produces another. When the cow is allowed to become abnormally weak or abnormally fat, she becomes abnormal in her uterus and a fevered condition locally, if not in general, takes place in her uterus, and there is no mucus to separate the adhesions after the calf is born. The question involves an answer for something to give in order to prevent. The answer is, give the cow good care which means also feeding a balanced ration when dry as well as when in milk, and during the last month of pregnancy a quart of oat chop and a tablespoonful of ground flaxseed (I don't mean linseed-oil meal), but the whole flaxseed ground. This can be given two or even three times daily, and will in most cases prevent the retention of the placenta. If the cow is on pasture the

flaxseed may generally be dispensed with; but the oat chop I consider an essential. The oat meal diet so often prescribed for a pregnant woman, is just as beneficial for a cow in more ways than one, and this is one of them. Medicinal agents have been recommended by various authors for a century, but I never have found one of them of any benefit whatever as long as the adhesions remain. The better way is to feed the cow in a manner that will prevent this abnormal condition, and oat chop and flaxseed properly used will do more to accomplish this than pounds of drugs.

THE GRASSES.

What will make the best combination of grasses for an upland pasture?

Mr. Van Alstyne.—Orchard grass, 4 pounds per acre; the same proportion of white clover, red-top, and the same money value of Italian rye grass and meadow fescue.

How shall we seed to "blue grass"? What soil is best, and how much seed per acre?

A Farmer.—I sowed seven bushels of seed on 20 acres a few years ago. I sowed it for both meadow and pasture. It did well. I suppose I sowed what is known as Kentucky Blue Grass, which I am informed differs from our State blue grass.

What varieties of grasses would you put on a steep hillside for a permanent pasture?

Mr. Cook.—I don't know. It would depend on the soil somewhat. Possibly a mixture of blue-grass, timothy, some clover and the fescues would be best. It is a question that is too indefinite to answer fully.

Will Kentucky blue grass do well on New York soil? If not, why not?

Mr. Cook.—What is known as June grass in many localities is nothing more or less than Kentucky blue grass. It is hardy in nearly all parts of the State and makes the best of June pasture.

How can quack grass be killed?

A Farmer.—I have killed quack grass on a field by growing tobacco one year.

Mr. Cook.—I incline to the belief that quack is a good grass to have. It is one of nature's ways of restoring humus to the soil, as it has a wondrous root growth. Then, too, it makes good pasture. But we kill a piece every year, no matter what the weather is, and it stays killed. We grow foods for dairy cows—oats and peas, three or four sowings, the last one, about the latter part of June. We take a piece of land full of quack, plow it deeply, early in the spring, then use a heavy disc harrow, weighted so that it requires four horses to draw it. We never use a spring-tooth, because it drags the roots all over the field, and, in a few days, if you do, the whole will be covered with a green coat. But the disc harrow will chop up the roots finely. Then we sow a crop of oats and peas—three bushels to the acre—this will smother the quack crop, in great part. When the crop is off, we plow the land, fit it well and sow to winter wheat and seed with clover. The next year there is never seen a spear of quack. The only way to kill a crop like quack is to stop its growing. Clutivation and the growing of such crops as I have named, will do it. Use the disc harrow every time, and use it often, till you are ready to sow the oats and peas. It will chop up the roots very finely, which leaves them when dead, in good condition for humus in the soil.

How can we best secure permanent pasture?

Mr. Terry.—I do not know what grasses would do best here (Weedsport), With us, "blue grass" is the best.

Mr. Van Dreser.—We use a mixture of red top, blue grass and alsike on low land. On upland, some timothy and clover are sown.

At what season do you recommend the cutting of timothy hay for best feeding results?

Dr. Smead.—I would not feed timothy hay to any animal; but, as it is being fed, and no doubt always will be, we must consider its food value. To get the most and best of that, timothy hay should be cut just as it goes out of the blossom.

If you were seeding a poor piece of land for pasture, what kind of seed would you sow?

Mr. Cook.—I would use orchard grass for one-half. The remainder I would have of meadow fescue, alsike, and perhaps, some other grass. But, if the land was natural pasture, I would top dress it liberally. I believe that better results will be thus obtained than to plow the pastures and reseed them.

Has anyone had any experience with brome grass?

Mr. Cook.—I don't know it. Does any one here? Director Dawley is experimenting with it at Fayetteville this year.

Is there as much moisture in timothy hay as in corn at the same stage of growth?

Mr. Cook.—I do not know. There is about 12 per cent. of moisture in dry timothy. I don't know how green timothy compares with green corn-stalks.

Mr. Moulton.—The stem of timothy is hollow; that of corn-stalks solid; so I do not think there is as much moisture in the timothy as in the corn-stalks.

What is the feeding value of timothy hay, and how does it compare with clover and corn ensilage? Will Mr. Gould please answer?

Answer.—There are but 750 pounds of digestible matter in a ton of timothy hay; the balance is sawdust. In clover there is 14 per cent., nearly twice as much digestible material, while oats are very nearly evenly balanced. To get the best results from clover and corn, cut the clover early and properly cure and house it; properly cultivate the corn crop and when in the proper stage, put it in the silo. A cow requires 14 pounds of digestible starch each day. To get it from these stalks, she would have to eat 45 pounds, which she could not do. In ensilage the ratio is still wider, being 1 to 17. But remember, the ensilage is succulent, not dry, and there is more of it that is digestible. Clover and timothy do not compare, any more than do corn and wheat bran. We grow the two crops to obtain entirely different results, our aim being to secure starch and protein. We, therefore, grow the timothy—if we do grow it—to obtain starch; clover to obtain

protein. Both are essential; but, I would not grow timothy except I could afford to grow and sell it, because I can secure so much larger per cent. of starch on a given area, from corn. I am satisfied that the farmer can easily raise 6,000 pounds of starch on one acre, while he will have to have a good season and well conditioned meadows to raise 1,500 pounds of starch in timothy hay. So it is easily seen that it is much more profitable to grow starch in the form of corn ensilage than it is to grow it in timothy. But, while a ton of hay will lay in a mow three or four years and not lose much of its feeding value, a stack of stalks, if left till next spring, will lose at least 60 per cent. of theirs. In short, the farmer must first learn what crops are best, then grow and feed them in the best form for the purpose for which they are required.

How shall we best reclaim old hillside pastures?

Mr. Cook.—I don't know just what I would do. It's a problem. We have lots of that hillside land in this State. Perhaps it would be as well as any way to put sheep on it.

VETERINARIAN.

What will kill pin worms in horses?

Dr. Youngs.—A mixture as follows will kill them: Oil meal fairn, ½ ounce; oil of turpentine, 2 ounces; linseed oil, 1 pint. Mix thoroughly and give a tablespoonful morning and night in the grain food, during ten days. Stop ten days, then give it again; repeat three times. It will require a period of about thirty days to perfect a cure.

What will prevent abortion in cows?

Dr. C. E. Hatch of Gainesville.—"Phreynol" is highly recommended. It costs $1.25 per gallon. It is used as a drench or wash and is quite reliable, fully as much so as are the patent anti-abortion preventives.

What will cure gapes in chickens?

Mr. Chapman.—There is no cure for gapes. The best way is to prevent them. To do this, keep the chicks on hard floors and

have them dry and clean. Gapes are caused by a worm which gets into the chicken's throat. If they are kept on board floors they will not get hold of the worms.

What is a good remedy to stop the flow of blood when an animal has been cut on barbed wire?

Dr. Smead.—That depends where the cut is and the magnitude of the blood vessel—a vein or artery. But the owner or doctor should not get excited, but keep cool. If the wound is on a limb and an artery has been cut, take a rope and cord the limb above it. If the cut is very large and there is a liability of the horse bleeding to death, the artery will have to be taken up. But every man cannot do that. To check the flow while waiting for the doctor, apply some muriate of iron. Every farmhouse should contain it. If the cut is mangled, cut out the broken or threaded pieces of flesh, then use a little carbolic acid—a teaspoonful to a pint of water—wet some cotton with it and bind it on the wound.

What will cure intestinal worms in sheep?

Mr. Van Dreser.—I know of nothing better than some of the sheep worm powders. There are a half-dozen of them. I don't remember the names—could not recommend either one. We feed them two or three times a week. Sometimes the worms come from old pasture grass.

What will kill lice in hens?

A Farmer.—That's what I want to know; there is a million on my hens.

Dr. Smead.—There are two species of lice that get on to hens. One is the little red mite that gets onto the hen in the night, but goes off and crawls into some crevice in the walls during the day. They do not stay on the hen during the day. Spraying with kerosene emulsion and whitewashing the walls and perches will kill the mites. The large gray louse lives on the hen all the time. To kill them blow Persian insect powder into the feathers a few times.

A Farmer.—A ball of camphor placed in the nests will kill the large lice.

Mr. Van Dreser.—Prepare a dust bath in a box, by putting in some sand, in which sulphur has been mixed, and allow the hens to wallow in it. Tansy in the nests will also kill the lice.

What will remove the diseased scales from the legs of poultry?

Mr. Ward.—They are caused by a parasite. Some one of the sheep dips, or diluted carbolic acid, will remove the scales. Wash the legs with it.

What will cure thrush in a horse's foot?

Dr. Smead.—Use either blue vitrol or calomel, after thoroughly cleaning the foot and cutting away all of the diseased frog.

What shall I do for a horse which has a "strain," and what is a good remedy for scratches on horses?

Mr. Converse.—Give some condition powders; then rub some carbolized oil on the scratches. I do not know what to do for a "strain." Possibly some of the liniments would be best. Consult a veterinarian.

What is sure death to lice on cattle and hens?

A Farmer.—A quart of good cider vinegar mixed with two quarts of water will kill every louse on cattle or hens.

Mr. Ward.—If you are so unfortunate as to have lice on your cattle, you will find nothing better than some one of the carbolic sheep dips, using one part of the dip to 50 of water. The mixture is good for many other troubles on sheep, cattle or poultry. In Scotland these dips are used to wash the legs of Clydesdale horses to promote the growth of hair.

Mr. Litchard.—Equal parts of lard and kerosene oil, rubbed thoroughly into the hair, will kill them. Not more than two or three applications will be necessary.

Mr. Cook.—If an animal is very lousy, diluted carbolic acid will kill them. Blanket the cow, then when the nits hatch give her another washing.

Mr. Ward.—Kerosene, lard and tobacco juice will kill cattle lice, but they are nasty and sticky remedies, while the carbolic dips are clean and just as available as are the other prescriptions.

What is good for scab on sheep?

Mr. Cook.—I suppose that means "What will remove scab on sheep?" What do you say, farmers?

A Farmer.—Use some one of the carbolic sheep dips. There is nothing better to cure sheep scab.

Dr. Smead.—Turn the sheep on its back, then pour a pint or more of some one of the sheep dips, from an old teapot, into the wool on the sheep's belly. It will go directly to the skin, covering it all over, without wetting the wool.

Why do cows chew pieces of boards and the siding on the barn, and what do they want when they have salt before them all the time?

Mr. Converse.—It is caused by a lack of mineral matter in the food. A little ground bone mixed with the grain ration will correct the habit.

Mr. Powell.—No doubt there is a deficiency of mineral matter in the food. Straw, cornstalks, timothy hay and other such foods are short of this mineral element. I would add some wheat bran, linseed meal, gluten or cotton-seed meal to the ration. We seldom see cattle chewing bones or boards when running in pasture in summer, nor when their rations are properly balanced in winter.

What is the best remedy for small white worms in horses?

Dr. Smead.—I suppose that refers to pin worms. There is nothing better than the skins of potatoes. Peel off the skins, having them thin, and give every morning about two quarts; do not feed them anything else, until after an hour.

What shall we use to kill nits on a horse?

Dr. Smead.—There are many things, but one does not always want to use the same thing on a horse that he would on another animal. Steep a handful of tobacco leaves in two quarts of water, then wash the horse. One application is enough.

What should be done with a cow that is to freshen in hot weather, to prevent loss from sickness or death?

Mr. Cook.—Keep her in the barn and feed her a little hay, some grain and a little grass. Do not turn her out into a good pasture

and allow her to fill herself with grass, because it stimulates the milk-producing functions too much, which tends to produce milk fever.

Why do pigs become lame and stiff? They are fed ground oats, corn and bran and have exercise.

A Farmer.—They need more exercise.

Another Farmer.—They have worms.

Mr. Converse.—Possibly it may be caused by rheumatism, or it may come from feeding too much corn meal.

Mr. Chapman.—Ofttimes the trouble comes from intestinal worms; a mixture of charcoal, salt and ashes put into the food, will very often effect a cure.

To Dr. Smead.—What do you think of the barbarous practice so many have, of feeding ashes and salt, mixed, to horses?

Answer.—The man who believes in that practice ought to take a dose of the mixture every day for a week. At the end of that time, if he is alive and likes the stuff, let him come around and tell me so. I shall then have nothing more to say.

What would you give a cow that has "run down" since she dropped her first calf and has partly lost her appetite?

Mr. Weaver.—There is a preparation—a tonic—that seems to benefit such a cow. I have not the prescription, but it contains some ginger, gentian, saltpeter, Peruvian bark, etc.

Mr. Cook.—A warm bran mash, if the cow will eat it, will be found about as good as the medicine. Don't spend a whole lot of money for these prepared, patent right foods and tonics. Some of them are good in their way, but they cost ten times as much as they are worth. As a rule, they contain 90 per cent. of linseed meal. They are just about as much of a fraud as is oleomargarine. Don't buy them. If a cow is ailing, call a good physician or veterinarian; or, as we always have some farmer among us who has had experience in doctoring sick cows, seek his advise. As a rule, he will know what the matter is and what to prescribe.

Are cattle benefited by being dishorned?

Dr. Smead.—I think it a benefit to dishorn the whole herd; but where one has but one cow I do not know that she will be benefited by it. As a rule, those who have had their herds dishorned are more than satisfied with the results. Indeed, I do not know of a dairyman who has had his herd dishorned who regrets his action.

At what season is it best to dishorn cows? Is it too late now?

Mr. Converse.—At any time when the flies are not plentiful. Cut them off now, but don't allow them to go out in the cold.

What is the most humane method of dishorning cattle?

Mr. Van Alstyne.—I think the clippers are best. We want to be quick about it, just as we would if we were to have a tooth pulled—we want to have it jerked out as soon as possible. I do not use the saw any more or take the cows out of the stanchions. There is no excitement of the cow, and but little blood to flow. But I know of a cow that bled to death; but it was the fault of the owner. We cut the horn close to the frontal bone, put on carbolized lard, then applied flour. If that does not stop the flow we apply spider's web.

If a herd of cattle has a cough, is it a sign of tuberculosis?

Mr. Converse.—That is a symptom, but the animals may not have the diseases. If one of my cows had such a cough I would call a veterinarian. But we have had cows which had such a cough, that did not have tuberculosis at all.

Is there any visible degree by which we may judge whether a cow has or has not, tuberculosis?

Dr. Smead.—Yes, when the disease is in an advanced stage; there are signs, but none when the disease is in the incipient form. I would require some external evidence before I would use tuberculin. It would be an unwise thing to use it, until one had very strong evidence. It has caused the destruction of many animals that have been tested and killed. Upon examination it was found that the tubercles in them were encysted and had become en-

tirely harmless. Some of the signs of tuberculosis in an advanced stage, are dull, watery eyes, languid appearance, degenerated appetite, a cough and a dry, hot feeling of the hair, etc.

What is the cause of tuberculosis; and is it catching?

Mr. Van Dreser.—I believe it is caused by a lack of constitutional vigor. I know of whole families who have died of consumption, but I do not believe it is catching; that is, I do not believe that a person perfectly healthy will catch tuberculosis—consumption from one sick with it.

Mr. Cook.—If you or I have a cow sick with tuberculosis, I think it is our duty to kill and bury her, and not wait for some man with a syringe to come around and puncture her, and then we ask the State to pay for her.

To Dr. Smead.—What are the first symptoms of the disease called tuberculosis? Is a cow troubled for some time before coughing begins?

Answer.—There are two questions involved. The first symptoms of tuberculosis in cattle or in any other animal, are very similar to those in the human. As a rule, at first is a general unthrifty appearance, which is followed by a cough. But the animal may cough and not have it. The cough caused by the disease is usually continuous and increases when the animal is hurried. The next symptom is a craving appetite. These are the first principal symptoms. The second part of the question—difficulty of breathing—may not be a symptom. It may be caused by some trouble in the nostril. One will have to investigate for the purpose of ascertaining whether such difficulty is caused by lungs or nostril disease. But, don't go away thinking that tuberculosis is a new disease. It is more than 2,000 years old. If you have a cow showing these symptoms don't imagine the whole herd is diseased. One animal may have it only. If you find such a one, quarantine it and give it the best of care and attention, and await results. Call some capable veterinarian and abide by his advice. If in time, the disease develops to such an extent that you are satisfied it has become chronic, slaughter and bury the animal.

Is abortion in cows a disease? If so, what is the remedy?

Dr. Jordan.—This question cannot be fully answered. Dr. Law of Cornell says he "gives it up." Good sanitary conditions, proper care, and a close watch upon the herd is advised.

A farmer present said that his herd, particularly the heifers, were most badly afflicted with the epidemic.

Mr. Cook.—I have no remedy; I wish I had. Several years ago thirty-six cows out of fifty in our herd, aborted. The second year the trouble came again, but in less number. Since then but four cases have occurred. When we have a case in our herd of 100 cows, we immediately quarantine the cow. Sympathetic cases have occurred in our herd, so that it is of the utmost importance that such cows should be isolated at once.

Captain Murphy.—I once had a heifer kick me on the knee; I gave her several cuts with the whip because I was angry; a few hours later, the heifer aborted. I was the cause of it. At another time one of my men was driving some cows to a fair; a railroad train came along and frightened them so that they ran down the railroad bank. A few hours later some of them aborted. I believe the disease is a nervous one, as it always occurs in our best cows.

Is there any cure for roup in hens, if so, what is it?

Mr. Van Dreser.—The cure is prevention. We have a large flock of hens, but when I was at home there was not a case of roup among them. If the houses are kept dry and no drafts of cold air pass through, it will not appear. Dampness causes it and dampness means death. If you find a hen sick with roup, the best way is to take her head off and bury her. Ground floors are damp; while rats will gnaw through board floors, so we use cement, but they are kept covered with straw; and straw should be kept on a board floor, so that the grain ration may be sprinkled in it for the hens to scratch, to give them exercise.

Dr. Smead.—Roup is caused by dampness, but there are three classes of it among hens. One is an influenza, one diphtheria, the other what is known as roup. To avoid these diseases, we should

have plenty of sunlight to destroy the germ that is destroying the hen. Then ventilate the house and remove the droppings often. If you have a valuable hen, quarantine her by removing her from the flock, then mix one part of carbolic acid with ten parts of linseed oil and sponge the head and face of the hen. We call it "carbolized oil."

Will sour milk cause indigestion when fed to calves?

Mr. Cook.—Not if fed carefully. As a rule, indigestion is caused by over-feed or by feeding too rich milk to young calves. But I would not feed very sour milk. There is a tendency on the part of most of us to over-feed the calf. I believe that mildly soured milk will not injure the calf, but I should prefer not to give the calf milk until it is two or three weeks old, milk containing more than two to three per cent. butter fat; later, I would feed skim-milk, sweet.

Is it well to give a horse linseed oil in his feed as oil meal? If so, how much would you give?

Dr. Smead.—Oh, no; linseed meal is a food very rich in protein, which makes blood, bone and muscle. Linseed oil is a medicine which is used sometimes in veterinary practice.

INJURIOUS INSECTS, INSECTICIDES, FUNGICIDES AND SPRAYING.

Is there a preventive of the "Buffalo fly?"

Prof. Felt.—I know of no remedy. Lime sprinkled on the droppings is doubtless the best preventive. We may keep the stable dark during the day, or spray with kerosene oil, but most of these remedies are only temporary.

Is there any remedy or preventive of the railroad worm in apples?

Prof. Felt.—The only remedy is to destroy the fruit, pick up the apples and feed them to hogs. Spraying will not affect the apple maggot. It will the codlin moth, however. We know that the moth does not fly far, so that if one takes care of his orchard, even if his neighbor neglects his, the insect may be quite largely obliterated in any one orchard.

Is the kissing bug dangerous?

Prof. Felt.—It is a myth. I have the pictures of at least sixty different bugs, all looking unlike, of the so-called "kissing bugs," in a scrap book, and all collected from different papers.

What will kill the pumpkin bug?

Prof. Felt.—I don't know what is meant by the term pumpkin bug, but I suppose the striped cucumber beetle is the bug. It may be driven off by spraying with some emulsion.

A Farmer.—I soak a piece of cloth in kerosene, tie it around a stick, and thrust the stick into the hill. Unless it rains it will keep the bugs away two or three days at a time. The scent of the oil keeps the bug away.

Prof. Felt.—I do not wish to discredit what the gentleman says, but I would not want to recommend anything as a *positive* cure until it had been universally used and proved to be effectual.

What is the so-called kissing bug?

Prof. Felt.—It is a smooth, shiny brown creature and has a wicked look in its eye. It resembles a squash bug somewhat, but if not disturbed does not bite.

Does the bite of a mosquito ever cause malaria or fever?

Prof. Felt.—Investigation made with certain species of mosquitoes in Southern Africa, where malaria is quite prevalent, shows that this is true somewhat, but they are confined to certain pools. Kerosene placed on the water where the mosquitoes breed, is said to exterminate them.

What is the best remedy for killing humbugs?

Prof. Felt.—I believe that the best receipt for killing humbugs is education. I know of none better.

What shall we use to prevent the lumpy, bumpy, humpy conditions of some of our apples?

Prof. Felt.—I have been recommending arsenate of lead for spraying purposes when a second brood comes on, because it adheres to the leaves so firmly; but paris green or london purple are

good. However, it does not pay to save five cents' worth of poison. Almost any of the poisons are good and I do not care to distinguish between them.

What is the name of the insect that causes the humps on apples?

Prof. Felt.—I am free to say that I do not know what the insect is. The only way is to watch the apple. A gentleman told me to-night that he had watched the apple all through a season and had been unable to locate the cause. I shall investigate and study it, however, as soon as I have a chance.

What is the remedy for the insect that attacks cherry trees? It attacks the leaves at the time of blossoming, curls their ends and blights the blossoms. The inside of the leaf along the main veining is covered with black insects that presently become flies. These black insects seem to attack the new leaves. I have tried soft soap, kerosene and paris green without success.

Prof. Felt.—I have but little doubt that it is the work of some plant louse. I would use some insecticide that will kill the lice when it touches them. Whale oil soap or kerosene emulsion will kill them; but one must begin early and be thorough. Poisons will not destroy them for the reason that they do not eat, but suck the juices out of the leaf, instead.

What shall I do to kill the lice or slugs on my roses?

Prof. Felt.—These slugs on the roses are of a family of aphis. Make an emulsion of soap kerosene and spray the roses with it, making it strong.

When is the proper time to scrape trees to kill the codlin moth?

Prof. Felt.—At any time in early winter or late fall will answer the purpose.

How often should orchards be sprayed to kill insects or worms?

Prof. Felt.—We spray orchards to kill insects and prevent scab, but there are two classes of insects, one sucks, the other eats, the latter may be killed by spraying with poisons, the other must be fought with emulsions. They breathe through holes in their bodies; kerosene emulsion, sprayed on them will stop up

these holes, and this will kill the insects. If we are to spray, we should know when and how to do it, and do it after the blossoms fall; spray two or three times.

What will destroy the oyster shell scale?

Mr. Van Alstyne.—The oyster shell bark louse or scale is easily removed by washing the tree with strong lye. As a rule, this scale only gets on to feeble, unhealthy trees. I don't know as I ever saw it on strong, well-fed, healthy trees.

Will Mr. Fenner please tell us with what he sprayed his pear trees?

Answer.—Paris green, 1 pound, with 100 gallons of water. Sprayed the pears three times, when the fruit was about the size of robins' eggs. We also spray with the Bordeaux mixture, just as the buds are starting; again later.

Mr. Cook.—How many of the farmers here have sprayed their orchards? Hands up!

A number voted, and one or two said they got excellent results —better than ever before—last year. One farmer said he got as good results from not spraying as did those who sprayed near him.

Mr. Cook.—You are like the man over at Mexico who said he got better results from the aquatic creamer than from the centrifugal separator.

What shall we do to save our plum trees from black knot?

Mr. Van Alstyne.—The black knot comes from a fungus. There is no way to hold it in check, or cure it by spraying. The only sure way I know is to cut out and burn all affected limbs; then I should apply some turpentine. It is said it will prevent the disease from spreading. If the tree is badly affected it is best to cut it down and burn it.

Is there any way to ward off the so-called apple maggot?

Mr. Van Alstyne.—I know no way of fighting this maggot. It seems to take more kindly to Talman sweet and other like colored apples, like Greenings and Fall Pippins, because they are thin

skinned. I know of no way but to stop planting these varieties and allow the hogs and sheep to run in the orchard to eat the wormy apples as fast as they fall.

Mr. Houck.—This maggot also works on Baldwins and Spitzenburgs.

Will Mr. Van Alstyne give us his experience for or against spraying his orchards?

Mr. Van Alstyne.—I do not believe I do a day's work in the year that pays me so well as that spent in spraying my orchards. It is a nasty job and I hate it because, sometimes, my wife hardly knows me when I go into the house. But I am not advocating it here because I want to say something at an institute, but because I know that we cannot be sure of fruit at all seasons unless we do spray, but it must be done thoroughly and intelligently. We spray for two purposes: To kill insects and to prevent scab on fruit, and leaf blight, using the Bordeaux mixture for the latter and poison for the former. After the blossoms have fallen and the fruit has set, we mix the poison with the Bordeaux, so that two purposes are served at the same time. Spray with the Bordeaux first—just as the foliage is coming out, and do it so as to cover the whole tree; later, add the poison to kill the insects—codling moth, tent caterpillar, canker worm and other insects that work on the fruit. And I would spray my orchard with the poison and Bordeaux if there were not an apple in it; not so many times, but I would spray to prevent leaf blight and to kill insects that work on the foliage, as, unless we grow a good crop of foliage this year, there will be no fruit buds next year, and, therefore, no fruit.

What will kill lice on currant bushes?

Prof. Stewart.—I have heard our entomologist say that there is not much hope for the currant leaf, if we wait till after the leaves are well out. But he intends to begin experiments by spraying the buds before they are very far out, with the kerosene emulsion and hopes to succeed. When the leaves are out the aphides cannot be very easily reached, for the reason that they

work from the under side of the leaf, where they suck the juices from between its walls.

What are the eggs on these maple twigs? Please notice them. Some twigs are covered with these eggs. What will kill them?

Mr. Van Alstyne.—Those are the eggs of the forest-tree caterpillar that works on the maples. The only way is to destroy the eggs. If they are allowed to hatch, very many will escape. Where they are on the ends of the twigs they may be clipped off. They are easily distinguished from the tent worm of the apple tree, and one ought to examine the trees and destroy the eggs. Green arsenite and arsenite of lead are also used in the spring and summer, the latter being much cheaper than the paris green; but it must be cut with potash, and, unless care is taken, the foliage will be burned. If the difference in price, as between the paris green and green arsenite was not much, I should use the former. If the difference was more than three cents I should use the green arsenite. It is more soluble and remains in suspension longer than does the green, and, therefore, does not need so much agitating while being sprayed on the trees.

What is the cause of bugs in beans and peas, and what is the best way to dispose of them?

Mr. Converse.—The worm is caused by a fly which punctures the pod and lays an egg, which produces a worm. The worm turns into the bug which we see. Bisulphide of carbon is the remedy. Saturate a sponge with it and place in the bin or barrel holding the beans or peas, then cover it tightly with a blanket. The gas is heavier than the atmosphere; therefore settles. It is not only deadly, but highly explosive; therefore, do not go near it with any fire, and be careful not to inhale it.

Does the planting of potatoes deeply, then hilling them up, prevent rot?

Prof. Stewart.—It might in some cases. The spores in the blight fall on the ground and are washed into the soil by the rains, where they fall on to the tubers and cause rot. So that, under certain conditions, if the potatoes are planted deeply the

spores cannot be washed down and lodge on the tubers, while those lying near the surface will be inoculated. When the potatoes are hilled up, if the season is wet, the spores are washed off and into the spaces between the rows. That is a part of the explanation of the remedy. Spraying with the Bordeaux mixture will be found a much better and surer preventive than the hilling-up system. I had much experience on Long-Island during one season, where we sprayed eight acres. We got no blight on either the sprayed or unsprayed vines. It cost $4 per acre to spray those potatoes, and, although we got no results in one direction, because the rot did not appear, we got 63 bushels more per acre on a piece of "White Elephant" than we did on the same area of the same variety that was not sprayed. But we used paris green mixed with the Bordeaux, which killed the potato flea beetle and other insects which feed on the vines. But it is the soft, stringy rot which the Bordeaux prevents. The dry, hard rot is a disease which works below the surface and will not be prevented by spraying. No disease working under ground that is not caused by something attacking the plant or vines above ground, will be prevented or cured by spraying. The hard, corky rot is not caused by leaf blight, but by a soil germ. So that spraying the vines will not reach the tubers.

Is there any spray that will destroy the moth spots on apples?

Mr. Tyler.—It is not the regular scab that is meant. To prevent the regular scab fungus, the Bordeaux is used as a spray. I spray before the buds open; then twice after the blossoms fall.

Would you spray for potato blight? If so, what ingredient would you use?

Mr. Litchard.—We have had but very little blight in our locality. I use vitriol, 4 pounds, and stone lime, 6 pounds. It is, practically, Bordeaux mixture.

Does the forest tree worm kill the timber?

Mr. Cook.—It would depend how severely he worked on the leaf. I don't know what can be done economically to kill them.

Of course they may be destroyed by spraying or by hunting out and crushing their cocoons, but that is out of the question in the forests. We can kill the apple tree worm, easily, but that is another worm. The apple tree caterpillar has a tent, the forest tree does not.

Is the maple tree catterpillar likely to kill our trees? Which is the best way to get rid of them?

Mr. Cook.—That question comes up at every meeting, but I don't know what to say. We can kill the apple tree worm, but the forest tree worm is another fellow. If we can reach them, paris green will do it, and I think the best way will be for the village board to take hold of it, and employ men to spray the trees in the village. When it comes to spraying the forest trees, however, it cannot be done. But some of the cocoons may be hunted out and mashed. We ought, I think, to give more protection to our song birds, which are our best friends. The women ought to make a stampede against wearing any more dead birds on their hats, and, instead of encouraging their slaughter, to protect them. We make too much fuss because the birds take a few berries.

A Farmer.—I have known men here to shoot a half dozen robins because they took a quart or two of cherries.

What is the best way to prevent or destroy the San José scale?

Mr. Cook.—Spraying with kerosene emulsion is said to hold the scale in check somewhat; but, to be sure of eradicating it, fumigation with hydrocyanic gas is the only cure so far known. But it cannot be applied to large trees.

Mr. Van Alstyne.—The scale is here in great numbers in some places. Long Island is filled with it, and it is in the Hudson river valley. A neighbor of mine has been fighting it in his orchards during the last ten years, and doing it intelligently, but he told me that it made greater headway last year than ever before. I have it on my currants, plums and peaches, and it may be on my pears, but I do not think there is any in my apple orchards; but it is in others in my vicinity, (Kinderhook), and I have come to believe that it is here to stay, and it is our duty

closely to examine all our trees and shrubs and to spray them, and, if we find it very prevalent, cut down the tree and burn it. It will not do to pass the matter lightly and thus neglect the trees, else all our orchards, shrubs and, it may be, our forest trees will soon be destroyed. Nor should we buy nursery stock of any one that has not been thoroughly inspected or fumigated. All the nursery stock sent out of the nurseries in Maryland is fumigated with hydrocyanic acid gas, which kills all insect life on it, and the result is that more orders are being received for stock there than the nurserymen can fill.

What is the best spray to kill the rose-leaf hopper? I have tried insect powders, whale oil soap, tobacco, etc., but they failed to have any effect on the hoppers.

Mr. Chapman.—Prepare a mixture made of 20 pounds of whale oil soap, 20 pounds of caustic potash, and 1 gallon tar. Put this in 100 gallons of Bordeaux and green arsenic. Spray the bushes with the mixture.

What is the remedy for blight on strawberries?

Mr. Converse.—Spray them before the blight appears, with the Bordeaux mixture. Do not wait for the blight to appear. Spraying will not cure, but prevent blight on strawberries.

What will prevent curl-leaf on the peach?

Mr. Mann.—I have sprayed with Bordeaux to prevent it, beginning just before the buds opened. Results so far are very satisfactory. I expected that Cornell would issue a bulletin giving full information ere this time.

Mr. Willard.—The foliage of the peach is very sensitive, so spraying must be done with great care.

At the meeting of the Western New York Horticultural Society, Mr. Powell of Syracuse, said that the San José scale could be communicated from apple peelings and orange peel, to trees, and thus spread. Was he correct?

Prof. Slingerland.—The San José scale does not work on the orange. That is another chap. There is a chance for a live scale to be communicated from an apple peeling to a tree, but only one

in ten thousand. It may be carried from one tree to another on the feet of birds or by insects, or through the action of the wind in blowing leaves about. Fumigation is the best preventive, but it may be carried to such an extent as to injure the nursery stock, the gas being too strong. Care must be exercised in this fumigating process to prevent that. There are other insects that infest the trees which nurserymen are sending out that deserve much attention, such as the bud-moth, canker-worm, codlin-moth and others. Fumigation with the gas will dispose of those at the same time it does with the San José and other scales. Therefore he favored the process, when properly and carefully done. Another point: It is asserted that the nurseries of this state are free of the San José scale, and no doubt the statement is true, but there is not a nurseryman of any note in the state to-day who does not sell stock he does not grow. While his own stock may be free from the scale, that which he buys and sells again may be infested with it. So, then, to be sure there are no injurious insects of any species on this stock, he would have it fumigated with the gas.

Mr. S. D. Willard.—New York auction rooms are filled in the spring and fall with nursery stock from other states with inspectors' cards attached, which are placed there during transit or after the trees arrive, and yet upon examination by experts the trees are found infested with the scale. This must be stopped. We have scale enough now. It is on Long Island and in the Hudson river valley, but I do not believe it is in any of the nurseries of the state. It is the stock from nurseries from other states that must be looked after. New York, under the present law, is the dumping ground of all other states which send out nursery stock, and it is this which must be attended to.

What causes blight on bean leaves?

Mr. Wilson.—I have been troubled with bean blight. I suppose it is a germ disease.

Mr. Harmon.—I think the trouble lies in overdoing the bean industry. We are growing crop after crop and putting but very little fertilizer back in the land. If we would abandon bean cul-

ture two or three years, I do not believe we would be troubled with blight. For myself I would say I have never been troubled with it much.

Mr. Cook.—Bean blight is a specific germ disease and appears on rich land just as often as on poor land. Such is the case on Long Island, where commercial fertilizers are used very largely.

A Farmer.—My experience is that blight has done the most mischief on my richest land, therefore I do not believe that the disease is due to poor soil.

Mr. Cook.—Possibly spraying with the Bordeaux will prevent the appearance of the disease, but it must be applied to prevent its appearance, not to cure it. It will never do that, any more than it will prevent potato rot if the vines are sprayed after they have been attacked with the rot blight. We spray potatoes to prevent, not to cure, rot.

Will Mr. Van Alstyne say a word in relation to the elm tree beetle?

Answer.—We have sprayed our elms with paris green—half pound in 30 gallons of water. We have 175 elms which we sprayed, two men doing it in three days. They climbed the trees and used a hose among the branches. If you have elm trees, the village board ought to look after them. Purchase a pump then employ a competent man to do the work. The English elms in some sections have been nearly destroyed by the worm, but the natives, being stronger and having better foliage, seem to resist its attacks. If one will carefully watch them, many may be destroyed before they hatch, because the fly lays its eggs at the roots of the tree, and when they have hatched, the worms crawl up the tree and begin their work of devastation by eating the young foliage.

How shall we rid a field that we want planted with potatoes, of wire worms?

Mr. Litchard.—Begin long before you want to crop the field with potatoes to frequently plow, and a rotation of crops will in time rid the land of them.

Mr. Cook.—Salt has been recommended for the purpose of killing wire worms. It was tried at Cornell, but the result was, the worms not only lived through the test but actually became fat on the salt.

Is there any remedy or preventive of the cabbage grub?

Prof. Hall. If the cut worm is meant, cultivation is best: If the green cabbage worm, dry poisons—paris green—sprinkled on is the best preventive I know. If the grub worms are located near the roots, it will pay to dig about them and kill the worms. Pinch their heads off.

How can smut best be prevented in oats?

Dr. Jordan.—At Geneva we have found "formalin" a good remedy. We will send a bulletin from Geneva giving full instructions how to use it. Smut is a parasitic disease and is spread by spores that live in various ways, blown about by the winds. Black knot on plums and cherries is spread in the same way.

MISCELLANEOUS.

To what extent does the sale of oleomargarine and butterine affect the price of butter, and is our law effective in New York State?

Mr. Flanders.—The first part of the first question is a "poser." I am inclined to think that the man does not live who can state just the extent of the injury done to the butter business of New York by the oleomargarine traffic. I think, however it is reasonably fair to say that every pound of oleomargarine displaces a pound of butter. There were 79,685,724 lb. of oleomargarine sold in the United States during the last fiscal year. The quantity sold in New York during that year was 222,788 lb. The quantity of oleomargarine sold in the different states in the Union during the last fiscal year is as follows:

Yellow Oleomargarine Sold Contrary to Law in 1899.

	No. dealers.	No. pounds.
Alabama	21	226.053
California	....	74,923
Colorado	95	1,123,537
Connecticut	5	134,255
Delaware	48	40,475
Georgia	61	495,004
Illinois	2,020	18,638,921
Iowa	3	79,922
Kentucky	217	1,490,577
Maine	17	102,274
Maryland	58	1,791,950
Massachusetts	108	2,083,889
Minnesota	30	1,343,865
Missouri	231	3,138,313
Nebraska	78	1,024,985
New Hampshire	19	445,583
New Jersey	296	5,875,975
New York	14	222,788
North Dakota	18	7,710
Ohio	1,005	8,830,969
Oregon	3	41,250
Pennsylvania	717	11,433,341
South Carolina	24	258,159
South Dakota	4	55,432
Tennessee	83	714,640
Utah	....	8,450
Vermont	1	2,990
Virginia	121	1,159,400
Washington	5	63,345
West Virginia	172	1,206,865
Wisconsin	23	714,742
Total	5,492	62,825,582

Oleomargarine Sold in States Where Legal to Color.

	No. dealers.	No. pounds.
Alaska	5	18,080
Arkansas	35	380,389
Arizona	5	78,767
District of Columbia	61	816,848
Florida	82	590,225
Idaho	3	58.224

	No. dealers.	No. pounds.
Indiana	306	3,923,228
Indian Territory	21	152,278
Kansas	186	1,658,544
Louisiana	140	1,043,502
Michigan	109	2,092,521
Mississippi	17	104,622
Montana	....	446,022
Nevada	....	625
New Mexico	12	115,850
North Carolina	9	110,224
Oklahoma	10	117,898
Rhode Island	333	3,594,984
Texas	162	1,518,264
Wyoming	5	39,547
Total	1,501	16,860,142

This shows that the quantity sold in New York was a little more than one-fourth of one per cent. of the quantity sold in the United States. I hardly care to comment on just what is being done in some of the other states to enforce their anti-color oleomargarine laws, but in New York it *is* enforced. Not a pound is made within this State and very little sold. What is sold is done under inducements offered by peripatetic agents. We are, however, catching them and punishing them.

What legislation is needed to stop the sale of oleomargarine entirely?

Mr. Flanders.—The first national legislation that is wanted is a law that will provide against the falsely branding or marking of dairy or food products as to the State or territory in which they are made. This will stop such marking as to interstate commerce goods and then the State itself can take care of internal matters. There should also be an act passed providing that when any dairy or food products are transported from one State into another they shall immediately upon entry become subject to the laws of the State, irrespective of the form or package in which they are done up. This would fix it so that there would be no question about enforcing such laws against the original importers' packages, and then after this legislation, if Congress would raise

the tax on colored oleomargarine sufficiently high, so it could not be manufactured and sold for a less price than butter, it would do away with the temptation for people to put it on the market and sell it as butter in States where State laws and State machinery are not sufficient to cope with the evil.

Would it be detrimental to educational interests of our schools to have an hour's agricultural talk each day?

Mr. John W. Spencer.—I would say, most emphatically, it would not be detrimental in the hands of any teacher competent enough to pass examination for a teacher's certificate. Of course, many teachers, by favorable temperament, could bring better results than others. The longer I am in this work, the more impressed I am that agriculture is valuable information to give city children. There are tens of thousands in the tenement district who do not know a dandelion. Teachers write me that when taking them to the park they throw themselves upon the turf and actually kiss it. In some parts of the sweat-shop district of New York not 50 per cent. of the children have been to any of the parks. This I believe to be credible information, having received it from principals who have worked in those districts for a dozen years. Details of rural life, you and I knew at such an early date that we cannot recall when we did not know them, are as interesting and wonderful to city children as though Stanley was relating something that he had seen in darkest Africa.

***Resolved,* That keeping more sheep, doing more ditching, using less phosphate and selling less raw material, is the only salvation on American farms. What do you say to that?**

Mr. Cook.—Amen to that. I am fully convinced that it would be much better for the owners of these rough, hilly farms if they would keep fewer cows and put on some sheep, and I would allow some of the hills to grow another covering of forest trees. As to phosphates, I do not want to say that a man shall not buy them. If I want them I shall buy them; but I do not believe that any man can go into the market and buy mixed fertilizers and get his money back. But I know that I have made a profit from

buying the chemicals, taking them home and mixing them myself. I have several tons of South-Carolina rock at home, bought at $11 per ton, and it is worth more now. But first save all the barn manure before buying phosphates; then, if you require more fertility, buy the chemicals, first ascertaining what elements your soils need to grow certain crops. As to draining, I will say that there are but few farms that do not have wet places that yield nothing. If those places can be tile-drained, they may be made the most productive places on the farm, at least for some crops.

In answering the latter part of the question, I will say that I am not in favor of drawing a crop off the farm if I can feed it to farm animals. We aim to feed all we grow, unless, at times, we can sell a crop and buy another equally good for feeding at a less price.

Do you advocate fall plowing?

Mr. Smith.—At the station but little or no fall plowing is done. Conditions will rule, or should. Where land can be plowed early in the spring, I would not fall plow. At the station farm, crimson clover and the vetches are used as a cover crop on most of the cultivated ground.

Shall we apply lime or wood ashes to sour soils?

Mr. Converse.—I don't think it would make much difference. Would use the ashes if I could get them. If not, I would apply the lime at the rate of 30 bushels (slacked) per acre.

What causes dry, gravelly or sandy soils to become sour?

Mr. Converse.—I have heard chemists say that the cause is from removing the humus, so that the plant food in the soil is not made available, and that the decomposing plant food becomes acid.

Does the presence of sorrel in our soils indicate acid?

Mr. Converse.—Not necessarily. Sorrel grows on all soils. Its presence is due, as a rule, to the absence of other plants, and to sterility of the soil. When a soil is well fertilized, cultivated and seeded, sorrel will not crowd out the crop.

Can cow peas be grown here successfully, if sown in the corn at the last cultivation?

Mr. Cook.—I have never sown cow peas, but I would say, no. It would not be safe to sow cow peas so late in the season as that. The frost would come along and cut them down before much growth was made. They should be sown early if a good crop is secured.

Is it advisable to grow one "special" crop on one farm?

Mr. Dawley.—It depends very much on conditions and the man's aptitude to the work. Much also depends on hired help. We can hire men to care for stock, but, when it comes to poultry, we find we cannot do it. It will depend on the aptitude of the individual, and the conditions that surround him, whether he can afford to make a specialty of one crop or not.

Mr. Cook.—I believe that, when a man can make money from one crop, he may safely try another. I have met dairymen who, notwithstanding they violated every dairy law, persisted in making money every year.

What shall I add to a good milk-producing food to fatten a dry cow?

A Farmer.—I would add corn meal.

Mr. Cook.—I know of nothing better, after much experience. If the cow is a dry one, I would add a little wheat bran and feed some ensilage, also.

Dr. Smead.—I think, if the ensilage was rich in corn, if much corn meal were fed bad results would follow.

Mr. Cook.—I would feed more of such foods to a dry cow being fattened than to one giving milk; but I would not feed too much ensilage. We do not want to feed too much concentrated foods, either to a dry cow being fattened or to a cow being milked. Nor would I feed all animals alike.

Prof. Stone.—It would depend upon the condition of the dry cow. If she were thin, I would feed more liberally of carbonaceous foods than I would if she were in fair condition. I do not think it safe to feed too liberally at first of carbonaceous foods.

Mr. Cook.—I think we often make a mistake in feeding our dry cows too liberally of refuse stuffs. The average farmer, if he has a good supply of straw, cornstalks or timothy hay, is inclined to feed too much of such foods. They do not furnish the requisite supply of blood to perfect the offspring, yet unborn. We must, therefore, feed such a cow more protein than we would to one being fattened. It is pretty hard work to formulate a ration for such a purpose because animals differ. But I have never found a ration better for such purpose than corn meal and wheat bran, half and half.

Would it pay to grow corn on good potato ground, where potatoes grew last year?

Mr. Harmon.—Yes. I have never been able to get along without a cornfield, and I think, as a rule, every farmer ought to have a cornfield. There are a good many dollars paid out for western corn every year, which is evidence enough that the farmers are not only feeding it, but that they are not growing it. I think that we ought to grow more of it, also more potatoes and less beans.

Why do not our state institutions buy home-made beef?

Mr. Ward.—I believe that one of the most serious mistakes the farmers of this State made was the giving up of the raising of beef. Last year the county of Genesee paid more than $400,000 for western beef. The State, outside of New York city, paid $30,000,000 for western beef. Now why not raise beef? I am just as willing that my money go to Germany or Cuba for sugar as to Nebraska for beef. If the farmers of this State are to grow beef successfully, they must have beef breeds, with full-blood beef sires. I do not believe there are a half-dozen pure-bred beef sires in Livingston county. We don't want general purpose animals, nor milk breeds, but the pure beef breeds. As prices are to-day, with such beef animals, the raising of beef in this State can be made profitable.

Is a canning factory a benefit to the farmer?

Mr. Cook.—I do not live near one; but, from what I have observed, where they are well managed they have been a blessing to the farmers. By this I mean a factory that is co-operative, not one built by a "canning factory promoter." If your system is that of the "promoter" I would let the thing everlastingly alone; otherwise I would go ahead and establish one, provided the farmers will agree to support it right along, so as to make it permanent.

Why are there so few farmers in the Legislature, each year?

Mr. Hale.—I put that question in the box. We have a farmer present who is also a member of the Legislature—Mr. Litchard. I would like to hear from him on the subject.

Mr. Litchard.—Last year we had but 16 members that were farmers, out of a total number of 150, in the Assembly. Although agriculture is of more importance than is any other industry in the State, it is represented but by few. The fault is with the farmers themselves. They are almost wholly indifferent to their needs. If they had been well posted in legislative and economic matters, they would never have voted for that $9,000,000 canal enlargement, which has never benefited the State to the value of a cent. We had 69 lawyers in the Legislature, many of them representing farmers. It ought not to have been, and would not be, if we would stand together and not underrate ourselves; and there will never be any change for the better until we reform our methods, learn to stand together and work for our own interest, and we must do it at once if we are to accomplish anything. Within the next five years more than one-half of the population of the State will live in the cities, and the representatives from those cities will be professional men, who will control legislation. So we must first agree on a policy and then stand together and enforce our rights.

Mr. Hale.—I agree with Mr. Litchard fully. It is the indifference among the farmers that is the main trouble. We ought to be

better represented in the Legislature, but I would tremble if we had a Legislature with a majority of farmers in it.

What position should the farmer assume toward the Erie canal? Shall the work of enlargement be continued?

Mr. Cook.—When we stop and think what the Canadians are doing by way of waterways, a canal across the State is of much importance. Now, how many here are in favor of continuing the canal appropriations? Hands up!

(Not a vote.) How many are in favor of abandoning it? (Half a dozen hands were raised.) How many would turn it over to the general government? (Fifty or more hands were raised.)

What must we do after planting corn, when the crows are so thick that they fairly swarm?

Mr. Squires.—I would put on corn enough for the crows, protect them, and shoot the boys that shot the crows.

Dr. Smead.—That's right; I believe the crow is to-day the farmer's best friend. Wherever we have been where crows are plentiful, the reports are that the forest tree caterpillar is but little known. I believe the crow is worthy of our protection; and there is another little inoffensive animal which gives off an offensive odor, which is being trapped for something for the ladies to wear—which is the skunk. It is claimed that he steals chickens and breaks up hen's nests, but he is another of the farmer's friends. We often hear the inquiry: "What shall we do to kill the white grubs in our soil?" This little animal is the best destroyer of them we have.

What can be done to decrease taxes?

Mr. Cook.—I am tired of this talk of being taxed to death. The town I live in receives from $5,000 to $10,000 more than it pays out every year in State taxes, from the cities and corporations. It is all bosh, this talk about our excessive taxes. There is a much greater taxation levied on wasted manure and rusted out

farm implements every year than we are asked to pay in State taxes.

What will be the cost per square foot for cement floors? Would you have the cows stand on the cement floor or on plank?

Mr. Cook.—This cement floor question is an important one, both from a sanitary and financial standpoint; but, owing to prejudice and a want of knowledge, there have been but very few cement floors put in until of late. Further cause was the high price of imported cement; now, however, we can get home-made cement fully as good, if not better than that imported, for one dollar less per barrel, so that, with this decrease in cement price and the increase in the price of lumber, the cement floors will not cost any more than the plank. There are several American brands of cement which are all good. If the foundation is good and water does not get into it, there will be no need of making a grout foundation. All there is of it, is to get a foundation that will not settle. We have cement floors that were laid directly on the earth, which have never settled.

Mr. Cook exhibited a chart on which was a crayon drawing which showed a cement floor and gutter in his stable or rather in the one which he will build this summer and which he fully described, thus making the explanation much better understood. He said he did not believe there would be any trouble with the standing on a cement floor, if, when it is finished, it is floated off with a board instead of being troweled down, as the surface will then be a trifle rough, so that the bedding under the cows will not slip off. If, however, one does not want his cows to stand on the cement, scantling may be imbeded in the cement, across the stalls and when the cement is hard, plank may be put down, but the gutters and the distance between the cows' hind feet and the gutter should be troweled down and be made smooth.

Would you use sawdust in a stable as an absorbent?

Mr. Converse.—Yes, if you can't get anything else; but straw is of much more value, if you can get it. Sawdust, on heavy land, might have a benefit in lightening the soil, however.

How will injurious affects of drouth in a corn and potato crop be best avoided?

Mr. Van Alstyne.—We cannot control the rain fall, but we may conserve the moisture already in the soil by frequent shallow cultivation which breaks up the surface cells in the soil and leaves a dust blanket through which the moisture cannot escape. Such cultivation pumps the moisture from below so that the roots of plants can use it. Keep the cultivator going, but at a shallow depth, not more than two inches at most. This for hoed crops. Of course, it could not be followed on sown crops or grass land. I am acquainted with a man who, by keeping his cultivator going, grew over $400 worth of red raspberries on a small plat last year. Had he not done that his crop would have been a failure.

A Farmer.—Thorough cultivation not only brings fertility from the lower depth of the soil, but has an action on the atmosphere which causes it to return fertility to the soil.

Mr. Van Alstyne.—There has been found a very small per cent. of nitrogen from the air, brought down by the dews and rains, but it is but slight. There can be no mineral matter obtained in this way, since there is none in the air. Potash and phosphoric acid come from other sources. But we may gather nitrogen from the air and return it to the soil through the growing of certain legume crops, such as the clovers, cow peas, field peas and beans. These plants have small modules on their roots, in which the nitrogen is stored, thence transmitted to the soil, but we cannot utilize this nitrogen, the mineral elements in the soil or that which we apply, unless we have moisture to set them free, so that the plants can take them in liquid form. So then, if we do not get the moisture through the rain fall we must get it by surface cultivation, as I before stated.

Which is best, fall or spring plowing for the corn crop?

Mr. Litchard.—Conditions will govern. On my land, I prefer spring to fall plowing.

What crop is the best crop to sow in the fall, to be plowed under the next spring?

Mr. Converse.—I would sow some crop that would add nitrogen and humus, and not at the same time remove fertility. I would not sow buckwheat, or rye, but the clover instead. Crimson clover may be sown as a catch crop in the corn or potatoes and left on the ground as a cover crop to be plowed under in the spring. I should never plow a furrow in the fall unless the soil was a very heavy one so that I could not work it early in the spring.

Should a farmer own a mill of some kind and grind his cattle food at home?

Mr. Cook.—We have a mill run by wind power. It will grind from eight to fifteen bushels per hour, depending on the amount of wind; we are satisfied with it.

Dr. Smead.—A year ago I bought a No. 1 sweep, one-horse power mill. It is ball-bearing and runs easily and will grind from eight to twelve bushels per hour. If I were going to buy another one, however, I would get a No. 2, which will grind from twelve to fifteen bushels per hour. It grinds very finely and costs no more for hired man and horse power to run it than it does to draw grain to and from a mill, while I save the toll. My mill cost me $20.25 delivered at my station; a No. 2 costs just $2 more.

Mr. Cook.—When we had our grain ground at a custom grist mill it cost us $50 per year for toll; that sum we now save.

Will Mr. (T. B.) Terry tell us what kind of soil his is?

Answer.—Ours varies from heavy clay to a loam. But some of it had to be underdrained with tile two rods apart to get out the water, to allow the clover to grow.

How much had a man with a farm income of $1,000 per year, ought to pay a hired man?

Mr. Van Alstyne.—It will all depend on the hired man. Some of them are not worth having about at any price. The best man I ever had I paid $22 a month and his board. Another one re-

ceived the same price and boarded himself, but was not worth, all times and things considered, much more than half as much.

How is it that plants can live in soil that is dust dry?

Mr. Cook.—They can't do it. But they will live in a soil that has only a dust mulch. The capillaries in the soil are thus broken up and the moisture pumped up from below, which the dust mulch prevents from getting away.

How can we secure free rural mail delivery?

Answer.—You will have to tackle your congressman. He seems willing to do all he can for Oswego county. So far, free mail delivery in the rural districts has given much satisfaction. It is not a new, but an old thing. But some of the fourth-class postmasters are opposing it because it is closing up some of their offices. But there is one great drawback—which is the bad roads. If we are to get rural free mail delivery, our roads will have to be made better than they are now.

Dr. Smead.—Wherever it has been demanded, as a rule, it has been granted. The chief opposition comes from the rural districts. The merchants and other tradesmen in the villages seem to have an idea that free-mail delivery will injure their business. Then there are some farmers who want to go to town, sit on nail kegs and talk politics.

Mr. Litchard.—I think that free rural delivery of the mails is in the near future, and sure to come. Changes are all the time taking place, but they come slowly. Our country school districts are in many places, being abolished, and the children all gathered into one schoolhouse in some central point; and I incline to the belief that the time is not far distant when the entire system in the rural districts will be changed.

Will the horseless carriage injure the market for horses or the bicycle?

Mr. Ward.—I ride a wheel, but I go round by a back street to avoid the rabble who ride wheels on the main streets, and I believe the day of the wheel has gone. Nor do I believe that the automobile will ever cut much of a figure, much less displace the

horse. They are a fad; besides, they cost too much and can be afforded only by the wealthy. No, the horseless carriage and the wheel are not in it with the horse, on the street or road, nor ever will be.

Is black muck good material for humus?

Mr. Van Alstyne.—There is some humus in muck, which will hold moisture. It is most beneficial on sandy soils. There is not much plant food, however, in muck.

Please give a sure but cheap remedy to get rid of orange hawk weed. People do not realize the danger from this beautiful weed.

Mr. Van Alstyne.—That weed is known in some localities as "Devil's Paint Brush," and, when allowed to grow undisturbed, will drive out nearly all other plants as well as the grasses. Where ground can be plowed and cropped, it may be eradicated by cultivation. A succession of crops will do it. But, where it has a foothold in pasture or land that cannot be plowed, I do not know of any remedy unless one resorts to the work of pulling it out. Mowing it does not seem to be effectual.

[See last year's annual report for article on orange hawk weed. —DIRECTOR.]

How shall we get rid of wild mustard?

Mr. Cook.—There is no patent right way to get rid of any of these noxious weeds, cultivation is the best way I know of. The department of agriculture at Washington sent out a bulletin giving directions how to get rid of these weeds, but, if anyone knows how fully to do it, I should be glad to know of it. Except it is done by a rotation of crops and good cultivation, mustard seed will grow after years of imprisonment in the soil even on an old pasture, when it is plowed. The great trouble has come from sowing grain impregnated with the seed. We ought to free all our grain from these foul seeds. If we will only be careful in that direction, we may easily prevent much of this trouble. But, with wild mustard I do not think that a rotation of crops will help much.

How can we get rid of kale?

A Farmer.—Pulling it out is the best way I know of.

Mr. Cook.—Thorough cultivation will do it, but the trouble is with the seed which will lay dormant in the soil during many years; but when given a chance will grow. The best remedy to prevent it from going to seed is to pull it out. It is an annual and does not make another crop, except from seed.

How can one prevent live-forever from growing?

Mr. Cook.—I don't know, except cultivation and rotation is followed. In Delaware county it was reported two or three years since that a parasite had appeared there which had attacked the live-forever and was killing it. I don't know anything about the truth of the statement.

How are we to get rid of plantain both on new and old seeding?

Mr. Litchard.—If the land is kept seeded all the time, I do not know what you would do with it.

Mr. Converse.—I see no other way except to give a rotation of crops. A three years' rotation and good cultivation will drive it out. I would not mow a meadow more than once. Plantain, wild carrot, rag weed and others may thus be eradicated by a rotation of crops and good cultivation.

Mr. Cook.—That is good advice; but there is a whole lot of land we cannot cultivate. On such land we can do little else but pasture.

How can we get rid of burdocks in our village streets?

Mr. Cook.—Call the trustees together and lay the matter before them. It ought to be their affair.

W. S. Moore.—Keep picking off the leaves and feed them to horses. They are very valuable for that purpose and are greatly relished by the horse.

Will the feeding off the green wheat in the fall produce chess as is claimed by some people?

A Farmer.—I think it will. I once knew a field of several acres of winter wheat which was fed down by a lot of calves at harvest time, one-half of the field was chess.

Mr. Ward.—Whatsoever a man soeth, that shall he also reap. There is a standing offer of $500 to any man who will bring a stalk and root on which wheat and chess are both growing. That is an old exploded notion.

Would you advise the using of a horse-rake after a harvester?

A Farmer.—What does that mean? If there is anything to rake, rake it. Ordinary rake teeth will not injure the ground or the seeding.

What would you plant on a field that has not had any manure, but has been growing wheat 50 years?

Mr. Hammond.—I would plow it, sow rye, plow it under, sow another crop, and plow that under. What is wanted is vegetable mold in such a soil; then we can fertilize.

A Farmer.—We need humus just as we need water.

Mr. Cook.—I am glad that I have struck one place where they ask for water.

Why does sorrel grow on some lands and not on others?

Mr. Hamilton.—Because the soil is barren, and other plants have been crowded out. Enrich and cultivate the soil, and sorrel won't grow on it. Its presence simply shows the absence of other plants.

How should bees be handled?

Mr. Faulkner.—Some men would put on gloves, and some would wear a veil. The time is not long enough here to go into a full description as to how to handle bees; but I will say that there are thousands and thousands of tons of honey going to waste every year for the want of bees to gather it. The bee not only furnishes one of the best of sweets, but it fertilizes blossoms that are barren, thus making them fruitful.

What will it cost to have samples of our soil analyzed?

Mr. Dawley.—Twenty-five dollars. But when you get it done, you will know no more about it than you did before. The chemists can tell how much potash or other plant food there is in a

sample of soil, but as yet, they know of no way to tell whether or not it is available for the use of the plant. So why should we ask the chemist to analyze any of our soils.

To Mr. Terry.—Would you advise every one to pursue the same rotation of crops you do?

Answer.—Certainly not. Circumstances differ. Then, if everybody grew clover and wheat, we would soon have a surplus. But you might grow clover, corn, wheat and potatoes. I know of men who practice such a four-year rotation.

Would corn take the place of potatoes in a clover rotation?

Mr. Terry.—Yes, nicely. I have friends who grow clover, corn, potatoes and wheat. Perhaps it is safer to make a four than a three-year rotation. We cannot afford to grow oats alone, but we grow oats and peas to feed, as a hay crop, cut just as the peas are filling. We do not grow oats alone, for the reason that it takes so much water to grow them, which is about 700 pounds for one pound of oats. It is this great drain of moisture that causes a small crop of oats in a dry season; not poor land.

Is Mr. T. B. Terry's rotation wrong? By substituting beans for potatoes, would it pay a farmer better than the one recommended by Mr. Converse?

Mr. Converse.—It will depend on the man and his conditions. Every man must answer for himself. With us the rotation I gave this morning is best. That was clover, corn or potatoes, oats and peas.

What does it cost to drain, with best tile, per acre?

Mr. Terry.—That will depend on the cost of making the drains, and that of the tile. It ought not to cost more than $25 per acre. On flat land one should have large tile, say four to five inches, which cost more than do the smaller tiles. We have some drains made by hand that cost $30 per acre; but where the drains can be made by horse-power and smaller tiles are used, the expense ought not to be more than $25 per acre.

How does Mr. Terry prepare his ground for wheat, after potatoes?

Answer.—We plow deeply, then use the cutaway harrow to fine the ground. It cuts up and quite thoroughly fines the vines from an early crop; for later varieties we rake up the vines draw off and spread them on our clover sod to be plowed under the next spring.

To Mr. Terry.—What soil is best adapted to phosphates?

Answer.—Phosphoric acid—which, I suppose is what is meant by the question—has best effect on a heavy clay soil. On sandy soils it does not seem to prove of much value.

Which is cheaper for drains, tiles or stones, if one has the stones and wants to dispose of them?

Mr. Ward.—I have had some experience with stone drains, and I am of opinion that, all things considered, the tiles are the cheaper in the end. I know of tile drains laid when I was a boy, that are now in good condition, while some stone drains laid later, are all stopped up and worthless.

Which is best for underdraining, tile or timber, and if timber is used, how should it be constructed to obtain the best results?

Mr. Van Alstyne.—If there is plenty of water, hemlock may be used, as it will last a long time, but will dry-rot quickly if in dry soil. Tiles, however, are always good, and, as a rule, all things considered, will last longer than will a timber or board drain. Round tiles are best.

Would seeding in July do as well as in May?

Mr. Van Dreser.—It would depend on the season. As a rule, oats take out too much moisture, especially from clover. July seeding in the corn has given quite good results, so has that sown in August.

What soil is best adapted for growing cabbage?

Mr. Van Wagenen.—A strong, easily worked loam.

How best to drive away the house rat?

Dr. Smead.—At one time my premises suddenly became over run with rats. Upon inquiry I learned that a neighbor who had

rats procured the services of a ferret which drove the rats over to my house. I secured the services of a ferret, which drove the rats all away. I don't know where they went. My opinion is, that a ferret, well trained, is about as serviceable as any remedy to dispose of rats.

Are the humming birds of benefit to the farmer or horticulturist in any way?

Prof. Stewart.—I don't know. Have never observed or made inquiry; but I have heard it said that the humming birds were very serviceable for the reason that they conveyed pollen from one blossom to another, thus fertilizing the barren ones.

I desire to raise celery, but have had no experience. I want to grow the plants and to know what kind of soil is best suited.

Mr. Chapman.—I grow a little celery every year. It requires rich ground; that which is a little moist is best. We sow the seed in boxes early, to give the plants a "good start." This is about the season to sow the seed. I make a trench with a plow and set the plants about six inches below the surface and four inches apart.

Mr. Converse.—Celery does best on a black, rich moist soil. Muck is the best.

After winter wheat, should the land be plowed for crimson clover, or will it do to harrow it, and, if plowed, should the ground be rolled? How much seed per acre?

Mr. Converse.—Yes, sir. Fit the ground finely. Sow six to eight pounds per acre, roll down the land hard, then stir the surface with a Breed weeder. If the clover is to follow oats, use the harrow instead of the plow.

I should like to know about the cultivation of asparagus. Would it be expensive to start a bed for profit? How far apart should the rows be made?

Mr. Abel Stevens.—Everyone who owns a bit of land should have an asparagus bed. Prepare the land by working it deeply and sow your seed next spring. The spring following, having

thinned the plants and top-dressed them with good manure during the first year, transplant them. Set the plants two feet apart and the rows four feet. Have the soil at least two feet deep, well fined, with ten inches of good barn manure in the bottom. Cover the roots with at least four inches of well-fertilized earth. As soon as the berries show cut out the plants bearing them. Cultivate often, and cut but few times the first year, and fertilize well with potash. Wood ashes or muriate will furnish the potash. If one wants but 100 plants he may buy them and thus save one year's time. But do not buy roots more than one year old.

What will prevent "club-foot" in cabbage?

Mr. Van Alstyne.—The best thing I know is not to set cabbage on ground where club-foot grew? I know of no cure for it where once it appears in the crop. It is said that it were better to plant the seed where the cabbages are to grow and not to apply hog manure. The turnip, cauliflower and other members of the cabbage family, when conditions are favorable, are attacked by the disease.

Dr. Smead.—Avoid heavy feeding with barn manure for either of those crops.

Mr. Van Alstyne.—Heavy feeding with commercial fertilizers will not have a tendency to cause the disease, because there is nothing in them to contain the disease germ.

How deeply would you plow a clover sod in the spring, for corn?

Mr. Litchard.—That would depend on the character of the soil. I would not plow a heavy soil as deeply as I would a dry, light one. Mine is a light, chestnut and oak soil, and we plow it about seven inches deep for corn, the same depth for potatoes.

What is the best all-round farm fence?

Mr. Eastman.—Not any; I don't believe in fences, except on particular occasions. Sometimes we find it necessary to fence in a new field, then I use wire.

Mr. Litchard.—The best fence I know of is barbed wire; the last work I did at home last summer, was to build 66 rods of

barbed wire fence. Its use is increasing every year, although we hear of some severe accidents to cattle and horses from it, but it is the best material for all that. The old rails in our county are going, while lumber costs too much to be used for fencing.

A Farmer.—Barb-wire fencing should be prohibited by law.

Mr. Cook.—I can count now fully a half dozen horses that were injured last summer by barbed wire; as a rule, it was done by the colt fighting flies when standing near the fence; in striking with his foot it was thrust between the wires that were close together, which cut the foot about the fetlock; one of the colts was permanently injured; I prefer the Page woven wire fence to any I know of.

Should the Grange elect farmers only for its officers?

Mr. Cook.—I think so, for the reason that the membership is mostly made up of farmers. We have a Grange in our town of 200 members, and another of 100 or more, and we have found that we prospered best when we elected farmers to office. If you have a barber, merchant or a man of some other profession in the Grange, keep him out of the master's chair. I know of two or three Granges which have stranded and gone to pieces because they violated certain fixed and essenial rules. If you have a man in your chair who will not live up to these rules, ask him to get out; if he does not do it, turn him out.

How about cow peas as a soil renovator when plowed under?

Mr. Terry.—Cow peas will, in part, do the work of clover, but I should not advise substituting them for it, especially in this climate, although they will grow on poor land better than will clover. I have seen five times as much growth from them on the same land and they will furnish a great amount of humus; but I prefer clover.

What class of reading is best for the average farmer?

Mr. Converse.—The Cornell reading course furnishes good literature. I have taken that course. It pays. Any one, whatever department of farming he may be engaged in, should read

farm literature suited to his business. I heard Prof. Bailey, of Cornell, say recently that there are now about 16,000 farmers in the State taking the reading course. Take it and also the bulletins from Geneva and Cornell. You will find them of great value.

Should not agriculture be blended with education?

Mr. John McManus.—I don't know that I am fully competent to answer that question. As a rule the boy who attends the district school gets some agricultural schooling at home before and after he goes to school. But I do not think it necessary to make agriculture a special study except in a casual way, in the district schools. The regular agricultural colleges and schools will furnish the farmer boys with the requisite schooling in that direction. Besides, I fear the district schools would put the study before the student so as to make it distasteful to him.

Dr. Smead.—I am convinced that the demand for agricultural study in the districts is growing, and that the time is not far distant when it will be introduced therein.

Why not seed on the sod and not plow so much?

Mr. Van Wagenen.—I do not know just what is meant by the question.

The Writer.—Why not seed with the first crop?

Mr. Van Wagenen.—As a rule, with us, when sod has been broken, it is not thoroughly enough broken up to seed it at the first plowing.

In fall plowing on clay soils, does it pay to plow more deeply, land which has been previously ploughed?

Mr. Van Wagenen.—That question cannot be answered categorically for the reason that soils differ; one may be plowed quite deeply while another may not.

Will Mr. Cook describe his disc harrow?

Answer.—A disc harrow is one with round disc-shaped wheels with sharp edges; wheels 14 to 16 inches in diameter. Have it heavy enough to be drawn by three or four horses, then weight it with 300 pounds of stone and a driver.

How shall we keep the boys on the farm; and why do girls dislike to marry farmers? I had no difficulty in finding a wife.

Mr. Van Dreser.—I know of one who seemed glad to get me, and they are marrying farmers every day.

If the boy on the farm will put intelligence and dignity into his work, and make his home such as it should be, there will be no trouble in coaxing a girl to marry him. Years ago when I went into Cobleskill I was jeered at and called a pumpkin-head, clod-hopper, hay-seed and other names of like character; and some boys are greeted that way now, but not many of them. Yesterday I had the privilege of talking with a number of members of the legislature who are farmers, and the number is increasing there every year. But, if a boy has not a taste for farming he ought not to be forced to stay on the farm. Such a boy will find some other occupation more to his liking. Allow him to follow it. There are many boys who are driven from the farm because all their surroundings are made distasteful, and because they are improperly educated. Give the boy who is to stay on the farm, an education to fit him for his calling: then make the home surroundings so pleasant that he will not want to go away. I know of no better way to keep the boy, fitted to be a farmer, on the farm.

Do you advise farmers to plant or sow cow peas? If yes, why? Have you succeeded in growing them in this State?

Mr. Cook.—Cow peas do not succeed where I live (Lewis county). It is not a pea, but a bean, and is a tender plant. I have not seen a man in this State who has succeeded in growing them. In New Jersey they are sown and mature perfectly.

At what season of the year should fence posts be cut?

Mr. Van Alstyne.—Cut them when the growth ceases; and I would set the large end down. But do not cut the posts when the sap is passing either up or down.

What price ought a patron to pay for making his butter at a creamery?

Mr. Van Alstyne.—I make some butter for my neighbors, taking three cents per pound for doing it. It is the usual price for

making butter, but the owner must market it; three and one-half cents seems to be the usual price when the creamery both makes and sells. It costs me just as much for making their butter as if I sold it somewhere else. Deduct that price per pound for the price it is sold for.

Do you know anything of the value of "Speltz" as a forage crop, highly recommended by a seed dealer?

Mr. Smith.—I know nothing of it, except that, as a rule, all these new-fangled things are no good. Go slow; don't invest your money in them. It would be much better to fit a piece of land well and then sow alfalfa. It is one of the best forage crops one can raise.

What will keep cider all winter, from working?

Mr. Litchard.—It is said that a good prohibitionist can keep it by putting in a little "sassafras;" I don't know how much, however.

Mr. Cook.—Heat it up to 130 or 140 degrees, strain it, add a few raisins, then put it into clean bottles and stop them tightly; in that way I am told it keeps very nicely.

What is practical farming?

Mr. William Eastman.—A farming that will pay in dollars and cents; nothing short.

Mr. Cook.—What might bring success to one farmer might not to another, and I think we ought to consider something else beside dollars and cents. But it has been my observation that the man who looks after little things and economizes, does best. It is a question of individuality and moral honesty more than any other.

On what crops is a weeder adapted? Can they be used on sugar beets and strawberries?

A Farmer.—On any common crop.

Mr. Chapman.—I have used the weeder on strawberries and raspberries, and I know of a man who used it on three acres of

sugar beets last year that produced twelve tons to the acre, but he ran it across the rows.

Mr. Converse.—It is one of the best tools on the farm. We use it on peas and oats for the purpose of conserving moisture. It may be used successfully on quite stony ground.

Do you prefer cement mangers for cow stables?

Mr. Cook.—I have not had any experience yet with cement mangers. We will build a barn next year which I will describe. It will have cement floors and gutters, at least, and possibly we may put in cement mangers.

Does it pay the farmer to keep his buildings insured?

Mr. Cook.—I think it does. I keep mine insured. All good business men keep their property and lives insured. Then why should not the farmer keep his property insured? Surely he is a business man, or ought to be.

How should seed corn be selected and cared for?

Mr. Litchard.—I think the best way is to go into the field and select the best ears when glazed, then care for properly and have it well cured out. In that way good seed may be secured.

Mr. Chapman.—It has been decided in Michigan that seed corn ought not to be allowed to freeze, as it destroys the vitality of the kernel.

A farm has 60 acres of meadow, 35 of pasture and 5 acres of wood: Which will pay best, to set more forest trees or cultivate the land?

Mr. Van Alstyne.—My opinion is that it would be better to allow such a field to grow up to timber. There is going to be a scarcity of timber, very soon. In the near future it will be very valuable, and, if one has such a farm as is named in the question, I believe that the best use to put some of it to, would be to allow nature to cover it with a new forest.

Would Mr. Hardy advise a college education for a farmer's boy?

Answer.—I do not think the farmers' or any other boys can have too much education.

When putting on a steel roof, should the old shingles be removed?

Mr. Cook.—I would most certainly remove all the old shingles and the nails, and relay the roof boards, placing them edge to edge.

Would it be advisable to use either cow or horse manure on land for Hubbard squash?

Mr. Ward.—Make a deep, large hill, putting a good supply of well-rotted cow manure in the bottom; round up the hill slightly and plant.

Mr. Converse.—I do not believe we can get as good results from hilling any crop. We can cultivate more easily, conserve more moisture, get better growth and a better yield, by giving level culture than by hilling. So I would give squash level culture.

Would it injure corn if one turnip is allowed to grow in a hill?

Mr. Smith.—I do not think it would make much difference with the corn; but I would not plant the turnip seed in the corn hill. I would wait till the last cultivation of the corn, say the 1st of July, then sow the turnip seed between the rows and cultivate it in.

How can we best improve the condition of our country roads?

Mr. Cook.—In our town we raised $1,500 for the purpose of benefiting our roads, and bought a stone crusher. But the man who runs the crusher must be a careful one whom the people will trust. It took us three months to work up a sentiment sufficient to get the appropriation, but we succeeded, and now hope to have better roads.

What sum can a non-resident farmer afford to pay a manager to look after his farm?

Mr. Cook.—Who knows? I don't. There are too many conditions involved in the question.

Mr. Rice.—I don't know how we can get at it. It would depend on the man, the size of his farm and the capacity of his pocket book.

Mr. Van Dreser.—You can't pay a manager too much if you have business enough to keep him at work.

A Farmer.—We don't need a manager. It is all we can do to manage the farms ourselves.

Mr. Cook.—There are a whole lot of fellows up in our county who need managers, but they don't know it. As a rule, however, a good wife is the best manager on a farm.

Is it best for one to follow mixed farming or should one devote his efforts to more than one branch?

Mr. Terry.—As a rule, however, when a man attempts to do a little of everything he does but little, and realizes but little. But, if I were making dairying a specialty, I would follow it. We are working out of potato-growing, and turned our attention more to dairying, for the reason that potatoes do not prove as profitable as they did a few years since.

What is the best way to have maple sugar, white?

Mr. Cook.—Keep everything clean. I have seen just as white sugar made in the old kettles as by the best recent methods.

Mr. Litchard.—That will do it. Keep out all foreign matter and be careful in finishing the product not to scorch it.

What are the greatest leaks in farming?

Mr. Van Alstyne.—I don't know. There are a good many of them. Probably the waste of manure is the greatest loss, the next is the loss in farm machinery and tools left out of doors to rust out and rot.

Dr. Smead.—There is another great loss which is in the improper feeding of our farm animals. Hundreds of thousands of dollars are lost each year in feeding unbalanced rations, often resulting in disease and death.

I do not hesitate to say that fully 60 per cent. of the cases I have been called upon to treat, in my profession as veterinary surgeon, during the last 30 years, has been caused wholly from the feeding of unbalanced rations. They over-stimulate the animal's stomach one way and starve it another. Result: Indiges-

tion, followed by some one of the diseases the animal is heir to; still the farmers keep right along, year after year, feeding only that which they have or can purchase most cheaply, despite all the warning and advice they are receiving from the institutes, agricultural stations and the press.

Is a cement floor for cows desirable in a stable?

Mr. Terry.—Yes, but I would not give much, if any, slope to such a floor, and I would have the cement of best quality as well as the sand; and have it well mixed; then the surface made just a little rough to prevent the cows from slipping while standing on it.

How does Mr. Gould fertilize his land when he follows corn with corn?

Answer.—I saw a man plowing under a crop of volunteer oats, self-sown, to-day; the crop covered the ground; if those were mine I would leave them where they are for a cover crop. If I follow corn with corn I always follow corn with a catch crop to cover the ground in winter, which is plowed under in the spring. When I came from home, peas I sowed in September were in blossom, but I don't expect any green peas from them.

Is there any preventive of smut on sweet corn, if so, what is it?

Dr. Jordan.—I know of none.

Would it be profitable to grow tobacco on a hilly farm?

A Farmer.—I am growing tobacco in a limited way on a hill-side farm, and I should like to have the experience of others on like farms. Of course it requires a good deal of manure; about all I make, so that the remainder of the farm does not get much, but I can take $100 per acre from the crop.

Two or three other farmers said they grew tobacco and could buy manure for $1 per load, and that 25 loads would manure an acre well and leave a good profit. Another farmer said he preferred to use his manure on his corn crop. It is king with him.

Mr. Cook.—If you can get $100 per acre from tobacco why not buy commercial fertilizers? Buy sulphate of potash, nitrate of

soda and South-Carolina rock. I should think it would pay. Would not buy the muriate, as it is said to injure the burning quality of the tobacco.

Would it be advisable to plow wheat straw under for a cover crop?

Mr. Converse.—I should use the straw in the stables for bedding, drawing it out every day and spreading it on land I wanted to plow in the spring. What I meant by a "cover crop," is some green one, sowed in the fall, such as clover or rye, to be plowed under the next spring.

Does the sun blast buckwheat? How much seed shall we sow per acre?

Mr. Cook.—As a rule, buckwheat does not "fill" in a hot, dry season, I suppose, because the pollination is not perfect. We usually sow about half a bushel of seed per acre. One great trouble in getting a crop of buckwheat is too much seed is sown.

Do you advocate the use of the smoothing harrow and weeder?

Mr. Converse.—Yes; we use both. The smoothing harrow has teeth standing backward at an angle of 45 degrees. We use it on corn and potatoes before the plants appear. Later we use the weeder. The object is to kill the weeds before they are born, and to conserve moisture. We also use it on oats and peas until they are quite high.

What is the best way to grow tomatoes?

Dr. Smead.—I wish I knew, but I don't.

Mr. Cook.—I used to train them on a trellis, but it is too much work. So I set the plants in rows, mulch them with straw, prune off the lower side branches, and let them go.

Is there an age limit in the use of a sire?

Mr. Van Dreser.—Mr. Hilton of New Scotland, had a Devon bull that was 22 years old, which was constitutionally strong and a good "getter." And I have awarded a prize at a fair to a Thoroughbred Guernsey cow that had dropped twin calves at the age of 23 years.

At what season should mangel-wurzel seed be sown?

Mr. Cook.—About the 10th of May, I think, is the best season in which to sow mangels. As a rule, all the beet family should be sown early in the spring. They thus get the benefit of the early spring rains while they are not injured by late spring frosts.

What is the best cover crop for St. Lawrence county?

Mr. Cook.—Perhaps the best cover crop here would be winter rye; but I do not believe any such crop is needed here, as, in nine years out of ten, the ground is covered with snow during the winter.

Would you plow corn stubble for an oat crop?

Mr. Ward.—Yes. We are going to plow corn stubble this spring for oats. I think it is the best place to grow them.

Mr. Hamilton.—I don't agree with you. I would not grow oats at all. They don't pay me.

What is the effect when leaving our plowed ground naked from September to May?

A Farmer.—We never have had a chance to try it in St. Lawrence county. As a rule the ground is covered with snow during that time.

Mr. Converse.—I would not plow in the fall, except as a matter of economy when I had a piece of ground that I could not get on to early in the spring. It is better to have some cover crop on the ground than to have it naked in winter.

How can a poor chestnut soil be quickly and economically made productive?

Mr. Terry.—I think I would begin by plowing under cow peas or clover to furnish vegetable matter. Humus, as a rule, is deficient in poor soils, and I think that cow peas are best. Mr. Gould says he sows five pecks per acre, and sows them as soon as all danger of frost is past in the spring.

What variety of carrots are best for the city market? Should they be large, small or medium varieties?

Mr. Cook.—Small or medium varieties sell best. We grow some of the yellow carrots in our garden. I think they are Ox Heart. Long and Short Orange are the best varieties. We do not grow them for feeding to stock; only for family use. We cook them so that they are fully equal to parsnips.

Is beardless barley as good as the bearded variety?

A Farmer.—Fully equal to it. I have grown it three seasons, shall keep on growing it.

Another Farmer.—I have sown it several seasons. Last year I harvested thirty-two bushels per acre.

What is the best method of improving worn out land?

Prof. Cavanaugh.—That is a hard question to answer. Probably the ideal method of restoring fertility to a worn out soil is by plowing under clover. The clover plant has the power of storing nitrogen from the air through nodules or warts on its roots. Follow with barn manure. If you do not have enough, use commercial fertilizers, first ascertaining what elements of plant food the soil most requires for the crops you intend growing.

Will timothy seed that has been hulled, grow as well as that which has not?

Mr. Cook.—I prefer to have it with the hull on; but if the conditions are all right, the hulled seed will grow just as well. By "good condition" is meant a fine, well prepared soil.

What will prevent rust or smut on wheat or oats?

Mr. Converse.—I have heard Prof. Beach say that it can be prevented by soaking the seed grain in water heated to 120 degrees. I believe two hours.

Are artichokes as valuable for swine and cattle as the seedmen recommend them?

Mr. Smith.—I do not believe I would try artichokes. They are no more valuable than potatoes for a swine or cattle food; at the

same time, when they once get into the soil it will be found very hard work to get rid of them. You don't want to believe all the stories the seedmen tell.

Would it be advisable to try cow peas as a soil renovator? If so, what variety is the best?

Mr. Smith.—The cow peas are a soil renovator; that is, they are a nitrogen gatherer. There are several varieties; one known as "Whippoorwill," another as "Little Black" are best. It might be well enough to try a few by way of experiment.

Are we now receiving benefits under the pure cattle food act; and upon whom devolves the responsibility of enforcing the law?

Mr. Ward.—I have a copy of the law and will bring it to the next session. The farmers are protected by it, provided they will help enforce it. They must demand an analysis of the prepared ground stuffs they buy. The law makes it obligatory on the part of the dealers to furnish such analysis, and the matter of analysis and enforcement of the law is left to the State experiment station. If the law is enforced and the farmer will find out what feeding values are, they will save hundreds of thousand of dollars every year. There is a firm in Kentucky that is grinding pure corn cob so finely that it cannot be detected except by analysis. This stuff is perfectly worthless as a food, but it is mixed and sold in wheat brans, and there are other mixtures fully as fraudulent.

Explain the difference between in-breeding and line-breeding?

Mr. Cook.—In-breeding is the breeding of sire to daughter; line breeding is the keeping of families of certain breeds together, without in-breeding.

How may I treat a clay soil that heaves very badly, to make permanent pasture or meadow, without underdraining it. Cannot afford to buy tiles?

Mr. Cook.—That is a problem. I don't know as I can answer fully. Possibly surface drains may be opened, so that the water will run off. But if water stands in the subsoil I do not believe that anything can be done with it till that water is out.

A Farmer.—I would suggest putting one blind ditch through that land as an experiment. Possibly such ditches will help it.

Does model farming pay in Allegany county?

Mr. Cook.—I don't know why "model farming" will not pay just as well in Allegany county as elsewhere. It certainly does pay in other counties, and judging from appearances in some localities, it does in Allegany county.

Does it pay the farmers to keep up good line fences?

Mr. Cook.—Line fences are necessary, so are other fences in some instances, but the old rail fences, whether on a line or somewhere else, are nuisances. It were better to take them down, dig out the bushes, plow the land, crop it a year or two, then build a wire fence. The old rail fence is a back number.

I have plenty of stone, and wish to underdrain a piece of wet land. Shall I use the stone or tile?

Mr. Ward I should put the stone into a wall and use tiles. It costs just as much to much the ditch for one as for the other, and just as much to cover it. Tile will last many years, while a stone drain will fail in a few years. I do not believe that any man can lay any quality or variety of stone in a ditch that will last very long. They soon clog up, and often rats get into them and make mischief. I know tile drains that I helped to lay when I was a boy, that are just as good as when laid. Ordinary drain tile may be bought cheaply and will last, when well laid, four generations; but do not make the mistake of getting too small tiles. Have them large enough. The depth to lay them will depend on the grade and the soil. We have laid them only twelve inches below the surface; but, as a rule, the tiles ought to be laid below the frost line. The distance apart will also depend on the condition of the land. The more water there is present, the closer should the ditches be; and, if very wet, it will be best to lay the tiles on boards.

Would you seed after winter wheat or some spring crop?

Mr. Ward.—Ninety-nine one-hundredths of our seeding is done on winter wheat in the spring.

How can hill lands be made remunerative to the farmer?

Mr. Cook.—What is the matter with allowing them to grow up with timber? Sheep and cows might be pastured on them.

A Farmer.—Some of them would not keep a woodchuck alive.

Mr. Cook.—Then allow the timber to grow if the land is as barren as that. But there are a great many acres of land in this State that are reported as barren, which analysis show to be full of fertility. The only trouble is, the fertility in them is not available. Cultivation and humus, when the land can be cultivated, will make this plant food available. When the lands cannot be plowed, the keeping of live-stock, with perhaps the addition of some potash, to give the grasses a start, will render the land productive.

Will clover and timothy "do well" if the seed bed is well prepared and the seed sown after harvesting wheat?

Mr. Cook.—Such a practice is being followed in some localities, and I have heard it recommended, but, to succeed, the ground must be well fitted and the seed sown as early as the first of August. If so done, it will have all the benefit of the land, as well as of the late summer and fall rains to give it a good start, and will establish it to withstand the winter and the spring variation of temperature.

Which will pay best, to cut hemlock into lumber or shingles?

Mr. Moulton.—Cut it into lumber. Hemlock makes a poor shingle; besides, they do not bring a big enough price as compared with hemlock lumber. It is much more economical to buy cedar shingles at the prices they are sold for now.

Will it pay the average farmer to take and read the experiment station bulletins?

Mr. Cook.—There are 350,000 farmers in the State of New York, but there are less than 40,000 of them who take the bulletins from Cornell and Geneva. One would think that the Grangers would take and read these bulletins, but it seems that they do not. There

are 60,000 Grangers in the State, so that if all who do take them are Grangers — but they are not — only two-thirds take them. Those who do, we always meet at the institute; and there are some others who attend; but, as a rule, the farmers who ought to attend, and who are in need of help and instruction, stay at home, or go elsewhere. The institutes are held for the benefit of these men, as well as for those who are here. Much information may be derived from the bulletins and the reading course sent out from Cornell University, neither of which cost anything. A postal card, on one side of which is written your name and address, if addressed to Prof. I. P. Roberts, Ithaca, or the Geneva Experiment Station, will bring you the bulletins from both experiment stations, as well as the reading course from Cornell—and all are free. But it is difficult to reach a man who has lived and worked just as his father and grandfather did. It is the same with the 16-year-old boy who is climbing "fool hill." He thinks he knows it all and there is nothing to be learned. You cannot teach either of them. The boy, by and by, will see the error of his ways, but the old, hide-bound farmer, never, except, perhaps, after watching his progressive neighbor, he adopts some of his methods.

A Farmer.—Only about one-half the Grangers and heads of families.

Will you please explain what is known as the "Cornell Reading Course," how is it carried on, how is it paid for, how one is to avail himself of its privileges, and what the cost, if any, is?

Mr. Smith.—The reading course at Cornell is carried on under the provisions of what is known as the "Nixon bill." By corresponding with the department of agriculture at Cornell one may get all needful information.

Mr. Rice.—In this reading course one may get all the agricultural fundamentals necessary. Besides, all high-grade terms are eliminated, and those which almost anyone will understand are substituted.

A Farmer.—I have been taking this course a year and have never found anything more instructive.

Mr. Smith.—How many of you have taken or are taking the course?

A half dozen hands went up.

Mr. Converse.—I think, Mr. Smith, that there are about 16,000 farmers now in this State who are taking the course.

Mr. Smith.—We shall be pleased to see the hands of those who wish to take the course. Mr. Windecker will take and forward the names.

Will Dr. Van Slyke please tell us how oleomargarine is made; also the difference between that and butterine?

Answer.—In the manufacture of oleomargarine, as commonly practiced, the fat is removed from the cattle in the process of slaughter, and, after thorough washing, is placed in a bath of clean, cold water surrounded with ice; where it is allowed to remain until all animal heat has been removed. It is then cut into small pieces by machinery, then cooked at a temperature of about 150 degrees F., until the fat separates in liquid form from the tissue. It is then allowed to settle until it becomes perfectly clear, after which it is drawn into the draining vats, where it is allowed to stand about twenty-four hours, when it is ready for putting in the presses. The process of pressing separates the stearin in solid condition from the remaining product, which is a liquid oil, commonly known as oleo oil. This oleo oil is then churned with cream or milk, or with both, and is salted and treated the same as is finished butter. The product is known as oleomargarine. In making butterine, neutral lard, made from selected leaf lard, is commonly used; but, in this case, no stearin is removed. This neutral lard is kept in salt brine during two or three days, at freezing temperature. It is then mixed with some oleo oil and butter, and churned with cream or milk.

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